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Air Pollution Control

FIELD OPERATIONS MANUAL

AIR POLLUTION CONTROL

FIELD OPERATIONS MANUAL

A Guide for Inspection and Enforcement

COMPILED AND EDITED
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1962

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FOREWORD

Those who have been concerned with the solution of community air pollution problems realize the multi-faceted approach required in any effective control program. This volume is concerned with a single facet of such a program, the field inspection and enforcement activity.

Much of the information included here necessarily is based on the fourteen years experience accrued by the Los Angeles County Air Pollution Control District. This organization for many years has been the largest community air pollution control agency in the United States. The size of the agency has permitted the organizational specialization of functions necessary to the solution of the Los Angeles air pollution problem. Although such special organizational activities might not be completely applicable to the programs administered by many governmental agencies, knowledge of the techniques and procedures successful in Los Angeles might nevertheless assist others in the battle against air contamination.

It is with this thought in mind that this manual is being made available for general distribution through the auspices of the United States Public Health Service, which also contributed to its preparation. This manual was originally prepared as a training manual for field personnel of the Los Angeles District.

Many officers and employees of the Air Pollution Control District have contributed to its preparation. We hope it has effectively tapped the combined experience and views of these people. The major writing and editing load was carried by Melvin Weisburd, who, for several years served the District as a Senior Engineering Inspector in the Enforcement Division.

The District, of course, bears full responsibility for the information contained in the manual. It is our hope that it may contribute to the growing national understanding on the control of community air contamination.

Smith Griswold

S. Smith Griswold
Air Pollution Control Officer

ACKNOWLEDGMENT

Under the provisions of the law creating the Los Angeles County Air Pollution Control District, the Board of Supervisors is empowered to act as the Air Pollution Control Board. The pioneering efforts of the Board over the past 14 years, the immediate adoption of advanced control techniques, the continued support of research and development projects and the prompt enactment of rules and regulations have resulted in the development of a considerable body of field enforcement and inspection practices. Without such support, the comprehensive field control operations program, as described in this manual, would not have been possible.

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CHAPTER ONE

THE NATURE AND EXTENT OF AIR POLLUTION

Ever since man has attempted to satisfy his basic needs by seeking ways to manipulate his environment more efficiently, one form or another of air pollution has been present to plague him. The various periods of human history — the ages of fire, copper, bronze, iron and atomic — testify to the fact that man has always engaged in air polluting activities. Initially, these were isolated in small settlements and towns and were treated as individual cases of smokes and fumes affecting only those persons living close to the sources of air pollution. But with the impact of the industrial revolution in the 18th and 19th centuries, cities grew and air pollution nuisances increased in frequency and complexity, giving rise to total pollution of entire metropolitan air spaces. The belching of black smoke from chimneys and stacks over residential and industrial areas, the blackening of the countryside with smoke and soot symbolized not only the Victorian faith in industrial progress, but also the gloom and squalor of the cities.

It was not until the twentieth century that the resources of science and technology began to be applied to the control of municipal air pollution with any degree of concentration. Engineers, meteorologists, chemists, and physicists began to investigate air pollution either as a concomitant to their basic interests, or as a direct attack on specific problems. Consequently, considerable knowledge of the nature and control of air pollution emerged. The problem of air pollution was subject to many professional disciplines, including engineering, law, public administration, economics, medicine, and most of the major fields of pure and applied science. While research findings cannot be said to be complete from the scientific point of view, the control of this historic problem is now within reach of society.

This manual is intended to complement the scientific literature on the subject of air pollution by dealing with the organization and administration of an air pollution program within the legal and economic framework of the community, and the operations conducted in controlling air pollution in the field. *Air pollution control field operations* are those activities conducted by a control agency which are intended to secure certain and continuous control of the sources of air pollution. While this manual is necessarily more concerned with legal and enforcement problems than with scientific analysis of air pollution problems, science and law are highly inter-dependent in air pollution. Field control objectives are predicated on scientific analyses of specific air pollution problems, while science, in turn, is dependent on the empirical evidence generated by control activities for a proper evaluation of pollution and control trends.

In implementing a practical field control operations program for any given community, three basic considerations must be taken into account. These are: (1) *the air pollution saturation potential of the air space* — the inherent capacity of the metropolitan air space to retain air contaminants, (2) *the pollution zone* — the characteristics of that land area in which the causes and effects of air pollution are concentrated in terms of the metropolitan economy, and (3) *the pollution potentials* — the capacity of the metropolitan economy to pollute the air in terms of contaminant species, rates of emission, and atmospheric reactions. This chapter is concerned with defining these variable groupings and with reconstructing their interrelationships with the view of establishing the objectives and limitations of a realistic field operations program.

I THE AIR POLLUTION SATURATION POTENTIAL OF THE AIR SPACE

A. *Definition of Air Pollution*

Air pollution is usually the unintentional result of the conduct of some activity which emits undesirable substances into the air in either one or combination of the following physical states: (1) liquid or solid particles capable of remaining air-borne either permanently or for significantly long periods of time, or (2) gaseous contaminants which expand and mix with the gases of the atmosphere. The contaminants may be subsequently changed from their initial state to liquid, solid or gas forms as a result of temperature, humidity and pressure, or they may undergo further chemical or photochemical change as a result of atmospheric forces and the presence of other reactive contaminants. The distribution of contaminants in the air from a multitude of contaminant plumes causes the formation of hazes or clouds, sometimes referred to as "smog" or "smaze". The properties of these smogs and the type of air pollution problems they produce depend upon the chemical and physical nature of the contaminants, and the concentrations they reach in the atmosphere.

1. Aerosols and Particulates

The diameter of contaminant particles emitted from man-made sources varies greatly in size, from about 1,000 microns* (near the size of raindrops), to particles substantially less than one micron. *Particulates* are considered to be particles generally larger than 50 microns, at which size they settle out of the atmosphere. *Aerosols* are usually particles which range in size from 50 microns to something less than .01 microns. Most aerosols are considered to be less than 1 micron in diameter.

---

*A micron is a microscopic unit of measure equivalent to 1/1,000 of a millimeter, or 1/25,000 of an inch.

Particulates are responsible for two basic types of air pollution problems: (1) soiling, corrosion, injury to clothing, property and crops as a result of deposition, and (2) adhesion of particulates to repiratory tissues, with possible physiological impairment or damage. Particulates may, therefore, include toxic substances, possible carcinogens and radioactive materials.

Aerosols tend to remain suspended permanently in the air and are usually emitted either in aerosol form, or evolve from the fracturing and decomposition of larger particulates, or they may form in the air from the condensation and nucleation of gaseous contaminants. The smaller the aerosols, the more they behave like a gas. Aerosols, therefore, are not as readily deposited as the particulates, and may be inhaled and exhaled with air. Aerosols are also important for their ability to reduce visibility through the process of light scattering. They may grow through accretion of matter, absorb water vapor present in atmospheres of high relative humidity (hygroscopic particles) and then settle out as particulates. Some thermal precipitation of aerosols on cooler surfaces occurs, but this effect is not significant. Much yet remains to be known about the properties of aerosols and their effect on the environment.

2. Gases

The gases significant in air pollution represent a wide range of organic and inorganic compounds, as shown in Tables I-1 and I-7.

Contaminant gases diffuse and mix with air, and to a small degree may alter the natural composition of the atmosphere. Gases are important for their reactive, toxic, irritant and malodorous properties in concentrations found in many urban atmospheres. The reactive gases, such as organic vapors, oxides of nitrogen and ozone, may participate in the formation of a number of other contaminants, both gases and aerosols. (See Part IV - B, this chapter.) The toxic and irritant gases include those emitted directly from the sources of air pollution, such as carbon monoxide, sulfur dioxide, and those deriving from atmospheric reactions, such as ozone and nitric oxide. The contaminant gases, most of which are invisible, appear to present the greatest possibility of affecting the health of the population.

"Ambient air quality"(3) may be defined as that composition of the natural and foreign constituents of the metropolitan air which may affect health, illness, death, damage to vegetation, and interference with visibility. In virtually all air pollution problems investigated, significant alteration of the natural composition of the air either by addition of a foreign constituent, or by an excess or depletion of vital oxygen, has not occurred. In relation to the total volume of air, the effects of gaseous contaminants, as well as those of the particulates, are manifested at extremely low concentrations. The total volume of air contaminants found in urban atmospheres is generally far less than one-tenth of 1 per cent of the total air volume.

3. The Sources of Air Pollution

To the extent that there is constant and varied activity taking place on the surface of the earth, the general concept of air pollution includes a large variety of specific air pollution problems. These can be divided into two broad classes: natural and man-made.

Natural pollution results from physical and biological processes in the earth's environment, and includes dusts or minerals ventilated from the soil, ash from volcanic eruptions, salt water crystals blown from the surfaces of large bodies of water and air-borne bacteria and pollen spores from an infinite variety of plant life. The atmosphere also absorbs quantities of solar and cosmic radiation from outer space. Short wave-lengths, in particular, influence the production of ozone at high altitudes.

Man-made air pollution, as it is known today, is a by-product of a civilization which has become dependent on its technology and industry for its survival. Modern civilization has progressed by the replacement, substitution or extension of manual or natural activities, such as those found in primitive economies, with mechanical devices and synthetic or fabricated materials. These involve industrial techniques, vehicular, marine and aerial forms of transportation, mass communication, rapid distribution of raw materials and manufactured products, centralization of energy and heat sources, together with all services necessary to the construction and maintenance of the metropolitan community. These activities can be reduced to three forms of air-contaminating processes: (1) combustion, (2) vaporization and (3) mechanical attrition.

The combustion of fossil fuels and waste materials for heat, steam and electrical energy is applied universally throughout the metropolitan economy to provide warmth, metal melting, motive power, food processing, incineration of waste materials, baking, tempering, curing, and many other processes. The products of combustion — smoke and gases — comprise contaminant plumes typical of all cities.

Vaporization or volatilization is a by-product of a large variety of chemical and manufacturing processes which induce physical changes in substances through the application of heat and pressure, thereby causing some component materials to vaporize in the atmosphere. Vaporization includes the evaporation of volatile materials at normal atmospheric temperatures and pressures; fuming as a result of induced temperatures; and decomposition of organic materials as a result of natural processes. Some materials with high vapor pressures will evaporate within the range of normal atmospheric temperature and pressure conditions. These include petroleum derivatives such as gasoline and fuel oil which are consumed by the entire economy, from motor vehicles and fuel-oil burning to organic solvent usage.

TABLE I - 1

CALIFORNIA STANDARDS FOR AMBIENT AIR QUALITY

POLLUTANT	"ADVERSE" LEVEL Level at which there will be sensory irritation, damage to vegetation, reduction in visibility or similar effects.	"SERIOUS" LEVEL Level at which there will be alteration of bodily function or which is likely to lead to chronic disease.	"EMERGENCY" LEVEL Level at which it is likely that acute sickness or death in sensitive groups of persons will occur.
Oxidant	"Oxidant Index" 0.15 ppm for one hour by the potassium iodide method (eye irritation, plant damage and visibility reduction)	Not applicable	Not applicable
Ozone		Footnote 1	Footnote 2
Nitrogen Dioxide		Footnote 3	Footnote 3
Hydrocarbons		Footnote 4	Footnote 4
Photochemical Aerosols		Not applicable	Not applicable
Carcinogens	Not applicable	Footnote 5	Not applicable
Sulfur Dioxide	1 ppm for 1 hour or 0.3 ppm for 8 hours (plant damage)	5 ppm for 1 hour (bronchoconstriction in human subjects)	10 ppm for 1 hour (severe distress in human subjects)
Sulfuric Acid	Footnote 6	Footnote 6	Footnote 7
Carbon Monoxide	Not applicable	30 ppm for 8 hours or 120 ppm for 1 hour (interference with oxygen transport by blood)	Footnote 8
Lead	Not applicable	Footnote 9	Footnote 9
Ethylene	Footnote 10	Not applicable	Not applicable
Particulates	Sufficient to reduce visibility to less than 3 miles when relative humidity is less than 70 percent	Not applicable	Not applicable

1. Ozone, at 1 ppm for eight hours daily for about a year, has produced bronchiolitis and fibrositis in rodents (Stokinger, H.E., Wagner, W.D., and Dobrogorski, O.J. A.M.A. Archives of Industrial Health, 16:514, (1957). Extrapolation of these data to man is difficult. Functional impairment data have been reported by Clamann and Bancroft (Clamann, H.G., and Bancroft, R.W. Advances in Chemistry. No. 21, pp. 352-359, 1959); at 1.25 ppm some effect is observed on residual volume and diffusing capacity. The variability of the tests was not reported. Additional data would be needed before a standard is set.

2. A value of 2.0 ppm of ozone for one hour may produce serious interference with function in healthy persons, and the assumption is made that this might cause acute illness in sensitive persons. (Clamann, H.G. op. cit.)

*3. Five ppm of nitrogen dioxide for eight hours will produce decreased pulmonary function in animals. Slightly more may produce pulmonary fibrosis (Stokinger, personal communication); nitrogen dioxide from air pollution exposures is usually combined with nitric oxide and ozone. More data on human exposures will be needed prior to setting a standard.

4. Hydrocarbons are a group of substances most of which, normally, are toxic only at concentrations in the order of several hundred parts per million. However, a number of hydrocarbons can react photochemically at very low concentrations to produce irritating and toxic substances. Because of the large number of hydrocarbons involved, the complexity of the photochemical reactions, and the reactivity of other compounds such as nitrogen dioxide and ozone, it is not yet possible to establish "serious" and "emergency" levels for hydrocarbons. From the public health standpoint, the concentration of those hydrocarbons which react photochemically should be maintained at or below the level associated with the oxidant index defined in the "adverse" standard.

5. Carcinogens include a few organic compounds such as some polycyclic hydrocarbons, and some metals such as arsenic and chromium. Studies on effects of such substances are currently under way, but there are not sufficient data, at present, to set standards. In the meantime, it is recommended that concentrations of carcinogens in air should be kept as low as possible.

6. A sulfuric acid mist level of 1 mg/M^3 with an average particle size of one micron will produce a respiratory response in man. (Amdur, M.O., Silverman, L., and Drinker, P. Archives of Industrial Hygiene and Occupational Medicine, 6:305, 1952.) It is not possible to generalize from this for all air pollution conditions, because under natural conditions, particle size will vary. Only with large droplets would sensory irritation be produced without other physiological effects.

7. A level of 5 mg/M^3 of sulfuric acid mist for a few minutes produces coughing and irritation in normal individuals (Amdur, M.O., Silverman, L., and Drinker, P. op. cit.). Presumably, it could cause acute illness in sensitive groups of persons in a period of one hour.

8. Given certain assumptions concerning ventilatory rates, acute sickness might result from a carbon monoxide level of 240 ppm for one hour in sensitive groups because of inactivation of ten per cent of the body's hemoglobin. In any event it is clear that when a population exposure limit has been set for carbon monoxide, because of exposures from other sources, community air pollution standards should be based on some fraction of this limit.

9. It is clear that lead levels should be set on the basis of average values for long periods. While data are abundant concerning human response to eight-hours-a-day, five-days-a-week exposures, data are insufficient for the effects of the continuous exposure inherent in community air pollution. While laboratory studies will be pursued with vigor, it becomes very important that local agencies collect data on existing lead levels. Since lead exposures are from multiple sources, community air pollution standards should be based on a portion of the total limit for population exposure.

10. Ethylene causes severe damage to vegetation. Ornamental plants are severely injured by exposures from 0.2 to 0.5 ppm. Tomatoes and fruit are adversely affected at similar levels. Current work is expected to permit a standard to be set within a year.

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*Note: In regard to Footnote 3, Dr. Stokinger suggests changes in the first two sentences so that they would read: "Five ppm nitrogen dioxide for eight hours will produce temporarily decreased respiratory function in animals. High levels (150-200 ppm) in short exposures produce fibrotic changes in the lungs of man that may end fatally". However, this change has not yet been approved by the State Board of Public Health.

Fuming includes both the phenomena of volatization and condensation of contaminants and takes place in acid manufacturing and handling and in metal melting operations where molten metal liquids are first volatilized to the gas state and then condensed to dusts by rapid cooling.

Decomposition of materials is associated with the handling of highly organic compounds or animal tissue with nitrogenous or sulfurous contents.

Mechanical attrition processes consist of crushing, grinding, drilling, demolishing, mixing, batching, blending, sweeping, sanding, cutting, pulverizing, spraying, atomizing of materials, etc., which either directly or indirectly disperse particulates such as dusts and mists into the atmosphere. These activities are involved in practically all aspects of metropolitan life and industry.

B. The Saturation Potential

The air pollution saturation potential is the capacity of that air space which envelopes a community to absorb, build-up and retain the air contaminants which are emitted from the sources of air pollution at such levels and for such durations as to be intolerable or annoying to the community as a whole. The saturation potential begins to be realized when the rate at which pollutants enter the air space of the living zone exceeds the rate at which they are dispersed. Because this potential is determined by many independent variables, it cannot be construed as a single physical construct in the way that air can be measured for saturation of water vapor, but must be rendered largely in descriptive terms. These include the range of air pollution effects manifested, and the meteorological conditions which accompany the air pollution problem.

1. Syndrome of Air Pollution Effects

As the concentrations of contaminants in the atmosphere increase, certain typical air pollution effects become apparent. The atmospheric concentration of contaminants at which an effect of air pollution is just noticed is known as the *threshold pollution level*. A community whose saturation potential has been realized will exhibit a "syndrome" of effects in which the thresholds of individual contaminants are reached or exceeded. By borrowing the medical term "syndrome", we may indicate the totality of effects resulting from air pollution which disturb a whole or major portion of an urban population, and which cause cognizance to be taken of the air pollution problem.

Initially, the syndrome is one of social unease, rather than an actual health or physiological problem *known* to exist (unless a disaster is involved), characterized by essentially subjective reactions, expressions of annoyance, and speculations as to the true nature of the causes and effects of air pollution. Upon investigation of the community problem, however, a syndrome will be revealed to consist of such effects of air pollution as reduction of visibility, physiological reaction and toxicity, soiling and property damage and public reaction.

a. Reduction in Visibility

Visibility reduction is due to the concentration of aerosols in the atmosphere and indicates an air pollution condition in the same manner that the clouding or darkening of a liquid may be said to be polluted by impurities. Two types of air pollution occur which affect visibility: (1) sky darkening, and (2) haziness or light scattering. In the former the sky darkens and visibility is reduced by the physical obstruction of sky illumination as a result of clouds of contaminants and plumes of smoke and fumes emitted from concentrated sources of pollution. In the latter, a haze evolves from atmospheric reactions which alters sky illumination by forward light scattering from the random disturbance of light photons by the invisible aerosols. The blue color of the sky, it should be noted, is the result of the mass uniform scattering of light from the molecules of atmospheric gases. Similarly, the color of the sky is altered by pollution hazes, depending on the size of the aerosols relative to the wave length of light. Between .4 and .9 microns, aerosols are most effective in light scattering. Early analysis of the Los Angeles atmosphere disclosed that 95 per cent of the particles sampled in smog were below 1 micron in diameter and that, as visibility decreased, the particles in the .5 to .8 micron range increased more rapidly than in the other size ranges.(17)

The nuisance value of visibility reduction appears to be relative to the climate, geography, population density and heights of structures, and the point of view of the average observer. This nuisance can be roughly expressed as the percentage of the maximum visibility normally available to the average observer reduced by air pollution. An observer accustomed to the restriction of his visibility due to high buildings, fog, overcast hills, etc., may not be able to see far enough to detect the formation of a pollution cloud unless he rises to a vantage point which increases his range of possible visibility. On the other hand, where visibility is normally unobstructed, the observer may view the formation of a pollution haze at a much greater distance since the cross-section of his view is obscured by the accumulation of aerosols in the depth of field of his vision.

The nuisance value of Los Angeles smog is realized by the role visibility plays as an aesthetic quality of the environment. Because the Los Angeles metropolitan area consists of large flat basin areas and low widely separated buildings, the appearance of a low-lying haze in all directions creates an inescapable nuisance. This may be indicated by the fact that the maximum visibility possible, from the sea to the mountains, is sometimes of the magnitude of 35 miles. During a smog attack, this visibility is reduced to less than 5 miles.

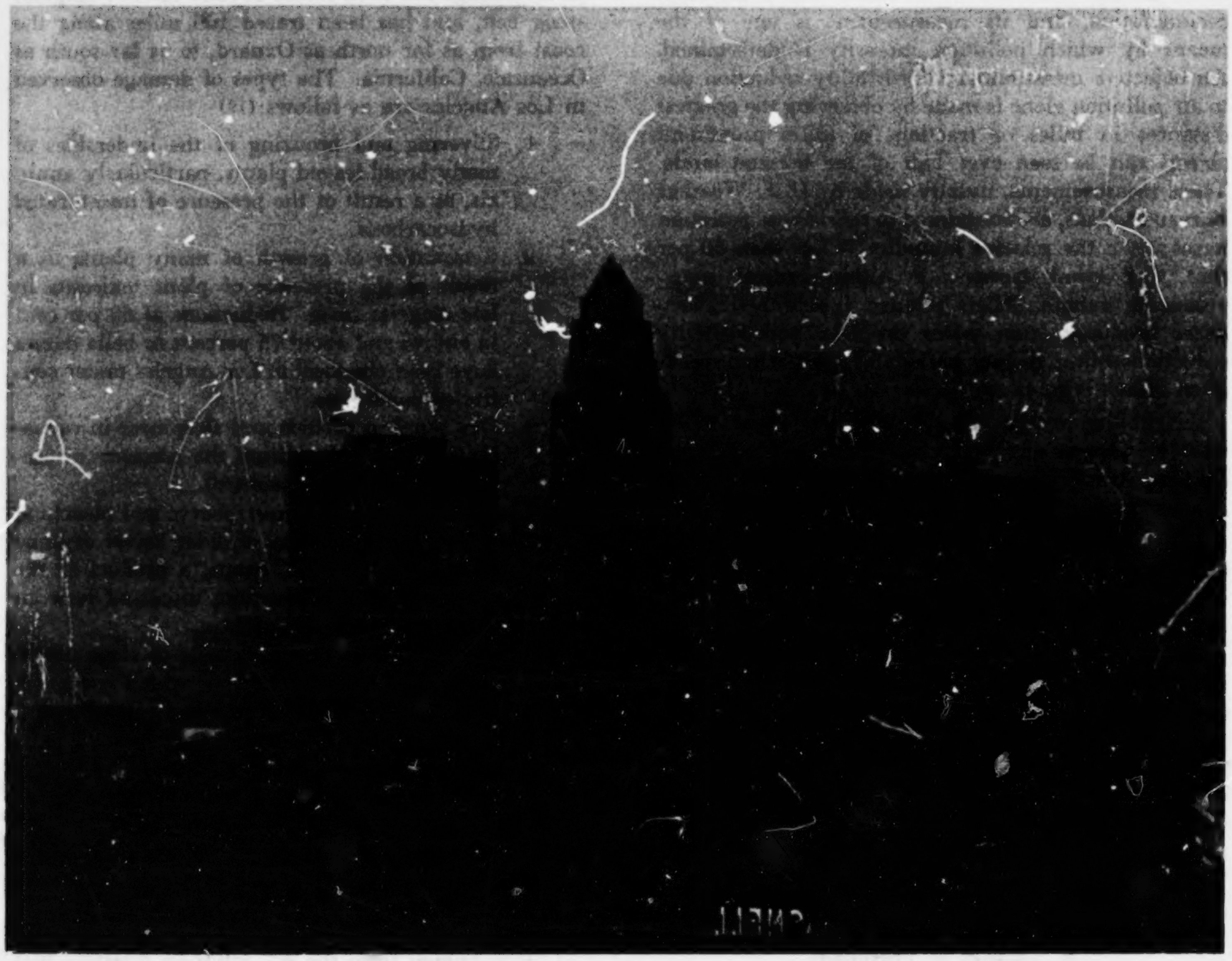


Figure I - 1. The above photograph illustrates visibility reduction as a result of smog formation in Los Angeles.

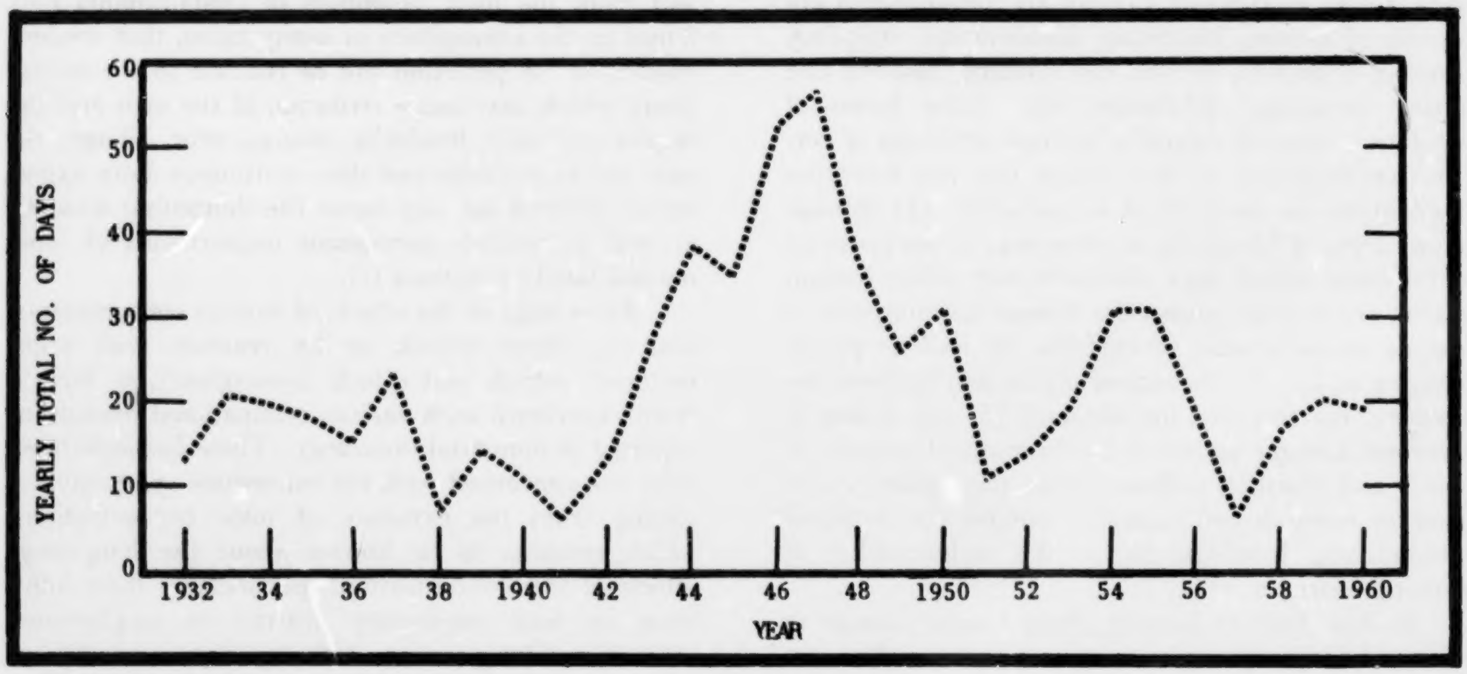


Figure I - 2. The above graph illustrates visibility reduction trends, measured as ¼ mile or less from the Los Angeles civic center at noon.

Visibility reduction is an indication of pollution accumulation, and its measurement is one of the means by which pollution intensity is determined. An objective measurement of visibility reduction due to air pollution alone is made by observing the greatest distances in miles or fractions of miles prominent objects can be seen over half of the horizon circle. These measurements, usually made by U. S. Weather Bureau Stations, are considered to reflect true pollution hazes when the relative humidity is less than 50 per cent, and wind speeds are within critical smog-producing ranges. High relative humidities reflect hazes produced from water droplets, and visibility reductions noted during periods of high wind speeds often reflect wind-blown dusts.

Visibility records can be used to show daily, weekly, monthly and yearly variations, and reflect the changes which take place in weather, the industrial economy, and the effects of control practices.

In the case of Los Angeles (Figure I-2), pollution during World War II increased sharply as a result of wartime activity, and then began to decline to a low in 1951, three years after the Los Angeles County Air Pollution District began operation. However, with the continued growth of population and industrial activity, days of minimum visibility began to increase once more, until it dropped off again after single-chamber incinerators were banned in 1957. Visibility studies of Los Angeles also show that more days of minimum visibility occur during the months of July through September, than during the rest of the year, and visibility is more severely reduced during the week, than on week-ends(15).

b. Damage to Vegetation

Injury and disease to sensitive forms of life such as crops and plants resulting from air pollution have been clearly established. Certain air contaminants are capable of causing bleaching, discoloration, stippling, stunting of growth, lesions, cell damage, spotting and pitting, drooping, defoliation, etc. Some forms of vegetation respond uniquely to concentrations of certain contaminants, a fact which has the following implications for the study of air pollution: (1) damage to any form of life serves to warn man of the presence of toxicants which may also adversely affect human health, cause crops grown for human consumption to become unmarketable or inedible, as well as poison foraging cattle; (2) damage of plants may indicate the chemical reactivity of the air; and (3) the extent of economic damage sustained by commercial growers of plants and crops in polluted areas may point to the need for research and control to remove the suspected contaminants from the air, or the undesirability of growing sensitive crops.

In Los Angeles County, smog causes damage to various leafy crops such as spinach, oats, endive, romaine, beets and sugar beets. According to Bobrov (2) plant damage has been found beyond the Los Angeles smog belt, and has been traced 100 miles along the coast from as far north as Oxnard, to as far south as Oceanside, California. The types of damage observed in Los Angeles are as follows: (19)

1. Silvering and bronzing of the undersides of many broad-leaved plants, particularly annuals, as a result of the presence of unsaturated hydrocarbons.
2. Retardation of growth of many plants as a result of the presence of plant toxicants in Los Angeles smog. Reductions of 60 per cent in endive and about 75 percent in bella-donna have been observed in Los Angeles under controlled conditions.
3. Dry sepal in orchids and sleepiness in carnations have resulted from the presence of ethylene in the atmosphere(18).
4. Stippling on grapes and tobacco and bleaching on the upper surfaces of older leaves of some plants as a result of ozone, a product of the hydrocarbon-NO_2 reaction, discussed later in this chapter.
5. Bleached areas between veins of some plants as a result of sulfur dioxide, which is capable of damaging plants at relatively low concentrations(25).
6. Other forms of damage to plants include cumulative poisoning from fluorine and lead compounds, damage to leafy vegetables and flowers from sulfuric acid aerosols, crop damage from insecticide sprays, etc.

c. Physiological Reaction and Toxicity

It is known from the air pollution disasters that have occurred in Donora, Pennsylvania, London, England, Poza Rica, Mexico, the Meuse Valley, Belgium, and from the toxic potentials of contaminants now found in the atmosphere in many cities, that concentrations of air pollution can be reached in the atmosphere which may cause irritation of the eyes and the respiratory tract, headache, nausea, odor, allergy, illness and even death and that continuous daily exposure to polluted air may cause life-shortening diseases, as well as possible permanent impairments of some normal bodily functions (3).

Knowledge of the effects of various contaminants, both by direct attack, or by reaction with other materials which will attack (synergism), is derived from experience with various occupational diseases as reported in industrial toxicology. These findings, however, are concerned with the immediate symptoms resulting from the exposure of toxic concentrations. Much remains to be known about the long-range effects of low concentrations, particularly their influence on such respiratory diseases as emphysema, asthma, and lung cancer. Although data is insufficient to prove such relationships, most informed authorities on the subject believe that they exist in some degree. In an effort to determine the potential adversity of contaminants on whole populations from the best information available, so that source control and automobile exhaust standards can be fixed, the State of California has established air quality standards, as shown in Table I - 1.

In Los Angeles County, eye-irritation is a leading known effect of air pollution and is a basic criterion in estimating the presence and severity of any smog attack. Studies show that eye-irritation generally accompanies the other end effects of smog, such as reduced visibility and crop damage(10). Its presence and severity, however, show no exclusive correlation with any single contaminant or group of contaminants.

d. Soiling and Property Damage

One of the first material effects of air pollution is the soiling of clothing, buildings and property. A familiar annoyance is the soiling of clothing and textile materials exposed to air containing smoke, soot and dust. Air pollution has a direct influence on the cost of cleaning and laundering, on the marketability of merchandise, and the cleaning of buildings. This cost to society is probably in the billions. Gibson estimates that the damage from smoke alone is about $1.5 billions annually(9).

Air pollution may also damage property. The damage is usually of a cumulative nature, tends to shorten the durability of materials exposed to the atmosphere, and is generally caused by the interaction of the contaminant with the surface or the protective coatings of materials in the form of *corrosion* (chemical or electrochemical reaction between metal, protective coating and the surrounding atmosphere containing contaminants, usually of an acidic nature), *erosion* (mechanical abrasion of surfaces by windborne materials), *oxidation* (such as rubber cracking from ozone and other oxidants present in the atmosphere) and *spotting* (contamination of surfaces by paints and oil droplets, carbon spheres and fly ash). See Chapter 12 for a fuller treatment of this subject.

e. Impact on Public Attitude

Not too much can be said about the psychological aspects of air pollution as comparatively little research in this area has been conducted. Several obvious psychological characteristics are manifest, however, particularly by a severe smog problem. First, of course, is the fact that, with the possible exception of "pleasant" odors, both animal and man attempt to avoid air pollution. Secondly, unlike crime which affects a small proportion of the population at any one time, smog affects everyone in the community at the same time, regardless of economic or geographical distinction. In fact, no other metropolitan problem operates with such thoroughness and simultaneity. Third, air pollution may devaluate real estate and contribute to the blighting of neighborhoods. There is no question, especially where the effects of air pollution on health are concerned, that chronic pollution may cause anxiety, frustration and anger, with whatever consequences these may have for individuals. For some, air pollution may merely embarrass civic pride, for others very definite psychological hazards exist, especially when air pollution becomes a subject of rumor. To the extent that smog reduces visibility, irritates the eyes, and soils the general appearance of the environment, it depresses general welfare and efficiency. One can easily imagine the psychological damage that can be created in a community which not only suffers, helplessly, from its smog problem, but from misinformed opinion, distortion, superstition and confusion.

2. The Evacuation and Build-Up of Contaminants in the Air Space

Since the rate at which a community pollutes the air can be assumed to be constant, only the variations in weather determine the intensity of pollution. For each community a set of meteorological conditions sufficient to create a characteristic pollution syndrome prevails.

The air space over the community consists of a volume of gaseous fluids subject to movement in three dimensions. Imbalances within large air masses cause individual air parcels to flow within the air space until equilibrium is achieved with the surrounding air. This essential instability of the air continuously favors the evacuation of pollutants.

Generally, the *more* unstable the air mass, the more vigorous the air movement, and hence, the less the pollution loading. Conversely, the more stable the air mass, the greater the pollution loading. We may speak, then, of the conditions which inhibit or favor evacuation, i.e., the ventilation versus the retention potentials. These distinctions are not qualitative opposites, but a matter of degree.

a. Evacuation of Air Contaminants

The mechanism of evacuation is expressed in terms of *dilution*, *dispersion* and *precipitation*.

Dilution is the diffusion of liquid, solid and gaseous contaminants in a parcel of air, and the mixing of that parcel with uncontaminated air until the concentrations of contaminants are so reduced as to be negligible or undetectable. The mechanism of dilution tends to cause a contaminant plume to mix uniformly throughout the entire earth's atmosphere. While diffusion, itself, is a slow process in still air, dilution is rapidly facilitated by atmospheric agitation, or *turbulence*, which is an irregular and random flow of air.

Dispersion is the movement of an entire polluted parcel of air either vertically or horizontally away from the living zone of the metropolitan area. Polluted parcels of air are dispersed by (1) the horizontal and lateral flow and mixing of air as it moves parallel to the ground in a stream or breeze out of the metropolitan air space, either at the surface of the earth (surface winds) or at heights above the living zone (winds aloft) and (2) the upwards movement of light warm air and its mixture with the fresh air above the living zone. The processes of dilution and dispersion are involved simultaneously, and quite often the term dispersion is used to include both mixing and transport.

The multi-directional flow of air masses is induced by three forces: (1) the drag of the earth's atmosphere over the surface of the earth due to gravitational rotation, (2) the movement of large masses of air from areas of high pressure to areas of low pressure, and (3) local climatological and topographical conditions (sea-land-valley-mountain effects) of a local area on the seasonal wind patterns.

The flow of any parcel of air is determined by its temperature and pressure in relation to the surrounding air. The differences in temperatures between adjoining air masses cause cool air to drain below warm air. Since the temperatures of the air are influenced by the temperatures at the surface of the earth, air cooled at one surface will flow towards air heated by an adjacent surface. Thus, a "sea breeze" is a condition in which the air cooled over a body of water flows inland towards the warm land. Quite frequently where a temperature gradient exists between two contrasting surface masses, such as the sea and the land, an alternating diurnal wind pattern prevails.

The vertical transport of air parcels is made possible by the decrease in air temperature with height. The air warmed near the surface rises quickly to the upper air where it is mixed with the fresh air aloft. This condition of decrease in temperature with height is known as the *adiabatic lapse rate*. A dry adiabiatic lapse rate is 5.4 degrees Fahrenheit per 1000 feet of altitude. A *superadiabatic* lapse rate is a more rapid decrease in temperature with height, a condition which is ideal for the rapid evacuation of contaminants.

Air is also cleaned by the natural *precipitation* of contaminant particles due to the (1) influence of gravity on particles of air pollution heavier than air, and (2) entrainment or nucleation of particles by water droplets in rain or fog. Contaminants which are water soluble will deposit to earth with rain and dew. Aerosols in the atmosphere may also "grow" by attracting other aerosols until they are heavy enough to settle out. Particles which are slightly heavier than air, however, may remain indefinitely suspended as a result of continuous atmospheric agitation. Some particles have aerodynamic properties which make continued suspension possible, whereas others may be deflected out of the atmosphere by centrifugal action in turbulent and gusty atmospheres.

b. Retention of Air Contaminants

Given the significant pollution potentials of most metropolitan areas, severe restrictions of all three escape mechanisms over a protracted period of time cause pollution to build-up. Restriction occurs when the dispersion of air contaminants is inhibited in all three dimensions — horizontally, laterally and vertically.

(1.) Wind Speeds and Patterns

The first important restriction to dispersion is the weak horizontal and lateral flow of air, and the pattern of flow. The pollution loading, under given stability conditions, varies inversely with the wind velocity, i.e., the slower the wind, the slower contaminant plumes dilute and disperse, and the longer the air remains significantly polluted. A critical wind speed may be considered for all metropolitan areas, given a constancy of other factors. As the rate of pollution of a metropolitan area increases over the years, the *critical* wind speed tends to decrease. For Los Angeles, with an average yearly wind speed of 6 miles per hour, a speed of 5 miles per hour or less is critical. During periods of severe smog, wind speeds are generally 3 miles per hour or less (13). The fact that smog occurs with such frequency and intensity in Los Angeles County is due to the fact that wind speeds are regularly lower for this area more days during the year than for any other major metropolitan community in the United States. The Los Angeles average of 6 miles may be contrasted to those of St. Louis (10 miles) and New York and Chicago (8 miles).

Wind speed is also important with respect to the distance a polluted parcel of air travels before it leaves the metropolitan area. The larger the land area of the metropolis, the longer a polluted parcel of air remains in the community. Air moving uniformly at a rate of 3 miles per hour across a 30-mile area (this is not uncommon in Los Angeles) may remain in the pollution zone for 10 hours during which time it continues to absorb other contaminants.

An adverse restriction of the dispersion factor is slow wind speeds in combination with a curcuitous wind pattern. A parcel of air which takes the fastest and most direct route out of the metropolitan area, of course, is being dispersed efficiently. But a slow-moving parcel which flows for a time in one direction, then retreats, cuts laterally over another dimension of the metropolitan area, or flows in a circular pattern, tends to absorb a maximum amount of pollution.

Many metropolitan areas exhibit a pattern of air movement favorable to maintaining a relatively fresh air supply, whereas others exhibit patterns favorable to the build-up and retention of pollutants. The Los Angeles area has a unique sea-land-desert effect which at times operates to entrap pollutants, and at others aids their escape. The alternating temperature differentials between the land and the sea may reverse the wind pattern and delay the departure of the contaminated air or an air parcel may be transported to a locality at a fairly brisk rate and then stagnate over a congested area due to changes in atmospheric conditions which take place as the day progresses. At other times, clashes between land and sea breezes may occur causing one of the opposing breezes to dominate. In still another situation, a "zone of discontinuity," i.e., an air barrier may form between two wind systems, causing the blockage of air (16).

An example of a build-up in Los Angeles is as follows: An air mass crosses the western coast line late in the afternoon and remains in the area to receive pollution for a period of less than 24 hours (Figures 1 - 3 and I - 4). This air mass may slow down due to the friction of the land mass or the opposition of a land breeze, causing it to stagnate in the vicinity of downtown Los Angeles the next morning around 8:00-9:00 A.M. The air remains in the general vicinity and absorbs pollution from automobile traffic congestion. The effects of air pollution — eye-irritation and reduction in visibility — then intensify until generally around noon when the air mass is released due to vertical mixing made possible by the lifting of the inversion layer (see below) or by the revival of the afternoon sea breeze. During relatively favorable conditions, the sea breeze disperses the air mass in a general northeasterly direction causing the polluted air to leave the basin in the afternoon. However, an adverse condition can occur when the atmosphere remains stable throughout the day and a slow land breeze forces the air mass to retreat in the direction from which it came (13, 20, 21, 22).

The Los Angeles wind system is thus a two-edged sword. It possesses temperature differentials between the surfaces of the sea, the land, and the interior desert regions which provide the escape of accumulated pollution each day. On the other hand, wind speeds occur which are slow enough to cause stagnation of the pollution in the metropolitan area. In some communities located in valleys, such as in the Meuse Valley or Donora, Pennsylvania, most of the polluted air may be trapped in the air space for longer periods of time. Unfortunately, the wind situation alone in Los Angeles would not be so bad if it were not for the fact that the vertical flow of air is also restricted.

(2.) Temperature Inversions

The dispersion of contaminants vertically is made possible by the fact that temperature normally decreases with height, causing warm air to rise and cool air to descend. The rate at which air masses rise depends on the rapidity with which the temperature drops with altitude. Normal adiabatic lapse rates are usually sufficient to permit pollution to escape from the living zone of the community. The continuous reduction of the lapse rate to conditions approaching little or no difference in change in temperature (isothermal) tends to cause contaminant plumes to rise sluggishly, or to remain suspended for long periods of time. However, when the temperature begins to *increase* with height (negative lapse rate) the upward movement of polluted air becomes impossible. This condition is referred to as *temperature inversion*.

An *inversion layer* is that layer of air through which temperature inversion takes place. The altitude of the inversion layer varies with height above the ground. The air *below* the inversion layer is that of the limited air space of the city, the temperature of which decreases normally with height up to the base of the inversion. The air *above* the layer cools indefinitely with height, unless there is another inversion layer at a higher altitude.

Since all of the polluted air below the warm layer is heavier, parcels of air warmed by the ground will rise and cool and will either reach a point of equilibrium below the inversion layer, or sink back to the surface of the earth again.

A "strong" inversion is one in which the temperature of the air forming the base of the inversion layer is significantly lower than the temperature at the top of the layer. Figure I-5 illustrates an example of this system. As shown, the temperature of the air at the ground is 80 degrees Fahrenheit, and thereafter decreases with height at the rate of 6 degrees Fahrenheit per 1,000 feet. The temperature at the base of the inversion is 74 degrees Fahrenheit and thereafter *increases* for the next 1,000 feet of altitude until it drops again at the top of the layer.

The inversion layer breaks when the meteorological factors causing the formation of the inversion are nullified, and normal temperature distribution is restored. The inversion layer may lift to such an altitude that it no longer has any material effect on the retention of air pollution, or it may lower to further intensify the pollution effects. In Los Angeles County, inversions form with particular strength and persistence, and are broken by rises in temperature of the surface air sufficient to raise the temperature of the inversion base above that of the inversion top. This temperature is called the *breaking temperature*. In the example in Figure I-5, the heating of the surface air to 103 degrees Fahrenheit is sufficient to increase the temperature of the air at the inversion top to 91 degrees Fahrenheit, one degree more than the temperature at the top of the inversion previously.

The maximum vertical dimension of the air available for mixing of polluted air in any one day as a result of inversion breaking or lifting is known as the *maximum mixing height*. The maximum mixing height is an indication of the maximum vertical dispersion factor for any one day.

Temperature inversions may occur under a variety of conditions, and with varying frequencies and

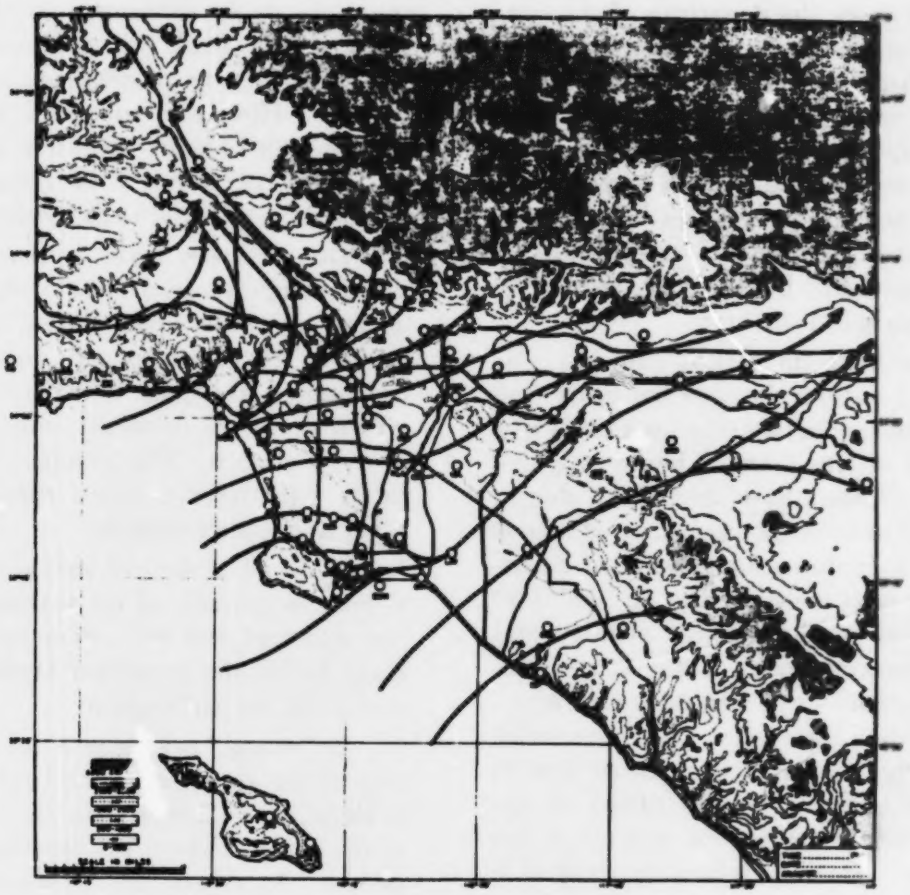


Figure I - 3. Streamlines for late afternoon over Los Angeles County.

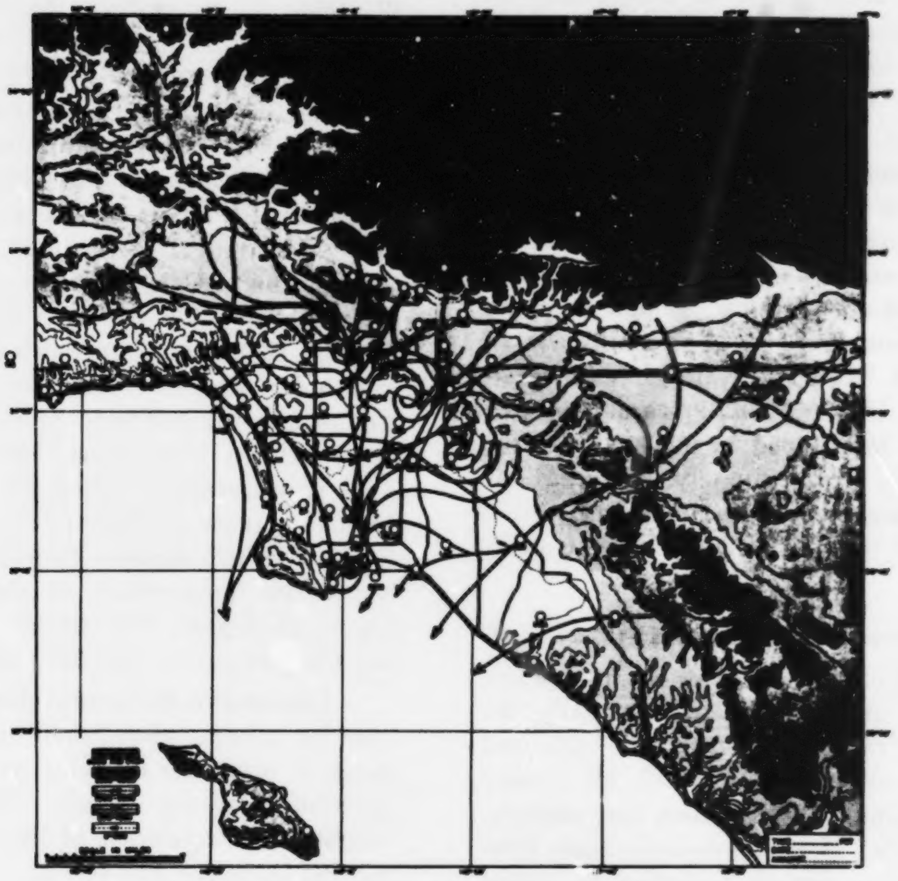


Figure I - 4. Streamlines for early morning over Los Angeles County.

persistence. Some types of inversion are: inversions formed by a calm before an advancing warm front; *advection inversions*, resulting from the drainage of cold air off the ocean under the warm air on the land; *radiational inversions*, resulting from the cooling of the surface air, usually during the evening or morning hours; and *subsidence inversions* forming from the heating of air under compression from a high pressure mass.

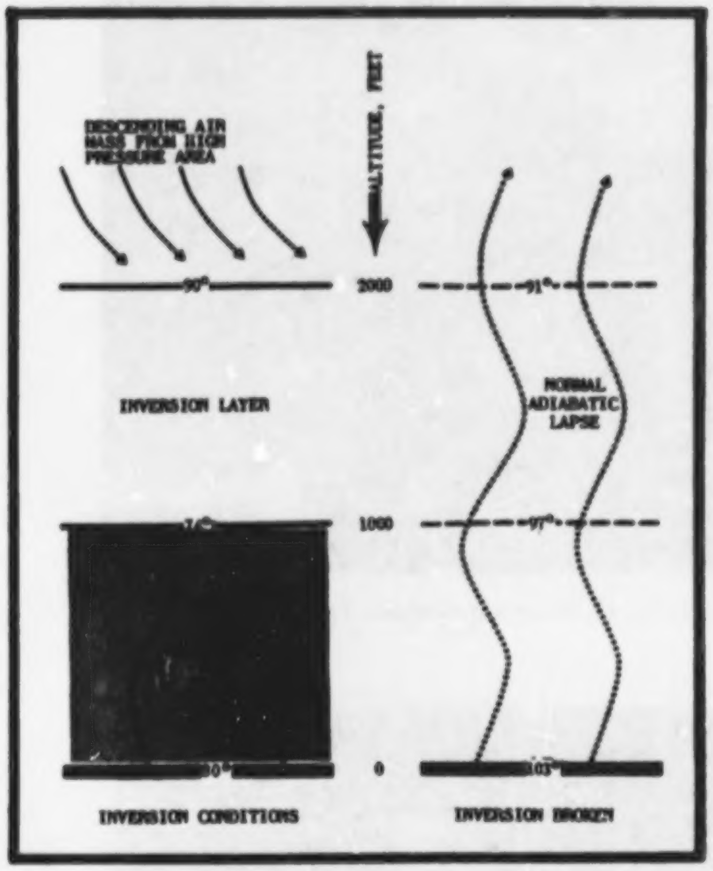


Figure I-5. The above profile of the Los Angeles air space shows typical vertical distributions of temperature during formation and dispersion of smog, respectively.

The two most important inversions are the radiational and subsidence types. Radiation inversions tend to form more in winter when, as a result of shorter days, the land is cooled more than it is heated, and during the evening and morning hours. In Los Angeles, radiational inversions are quite common between 2:00 and 4:00 A.M.

In Los Angeles County, the subsidence inversion is of greater importance due to its duration and frequency, particularly during the late summer and fall. The subsidence inversion is a feature of the west coasts of continents, and extends on the west coast of the United States from Baja California to north of San Francisco, some 340 days each year. This inversion evolves from the descent of a high pressure cell, centering north of the Hawaiian Islands, which swirls gigantic air masses down and around in a vast clock-like motion towards the Pacific Coast. As the air is compressed, it heats at about 5½ degrees during each 1,000 feet in its descent. Strong inversions are present within 1,500 feet of the earth's surface on about 120 days of each year. While there are variations, Pacific Coast inversions average about 2,000 feet in depth, and possess a temperature differential between base and top of about 7 degrees Fahrenheit.

(3.) Topographical and Geographical Effects

Other impediments to contaminant dispersal arise from the barriers to airflow present in the natural and man-made environment.

The character of the surface of the earth has an important bearing on air turbulence, wind speed and direction. Smooth, level land offers less of an impediment to airflow, than does land which is rough or rocky, hilly, mountainous or congested with tall structures. Irregular surfaces, while contributing to greater air turbulence tend to retard the flow of a whole air mass. Hills, tall buildings and rises in land may create down-washes causing polluted air to flow at ground levels. Of even more importance to pollution retention however, is the general physical geography of the metropolitan environment. Cities appear to have grown on sites favorable to pollution retention, i.e., sheltered low-land regions or river valleys which either adjoin large bodies of water, or through which rivers flow. Although variations in geography resist generalization, four different types of land formations are relevant to the retention of air pollution. These are: 1) valleys, 2) coastal basins, 3) peninsulas, and 4) inland plains.

(a) Valleys

Valleys present the topographical conditions most favorable to the build-up of contaminants. Valleys are low levels of land enclosed by mountains. Depending on the heights of the mountains and the narrowness of the valleys, the circulation of the air is usually confined within the valley, although some air flows up and down the sides of the mountains and through the passes between either end of the valley. (A mountain breeze flows down the mountain slopes at night, and a valley breeze flows up the slopes during the day). Low-lying temperature inversions are critical in valley situations, frequently causing contaminant plumes to intersect rises in land. Most of the air pollution disasters have occurred in valleys.

(b) Coastal Basins

Like the valley, the basin is an area enclosed by higher land. The basin, however, is not necessarily enclosed on all sides and usually adjoins a large body of water. The Los Angeles Coastal Basin (Figure I-7) consists of an area of more than 1,200 square miles ringed on the north and east by the Sierra Madre mountain range and rising to an average height of more than 5,000 feet and to a maximum height of 10,000 feet at Mt. Baldy. From the mountain ranges, the

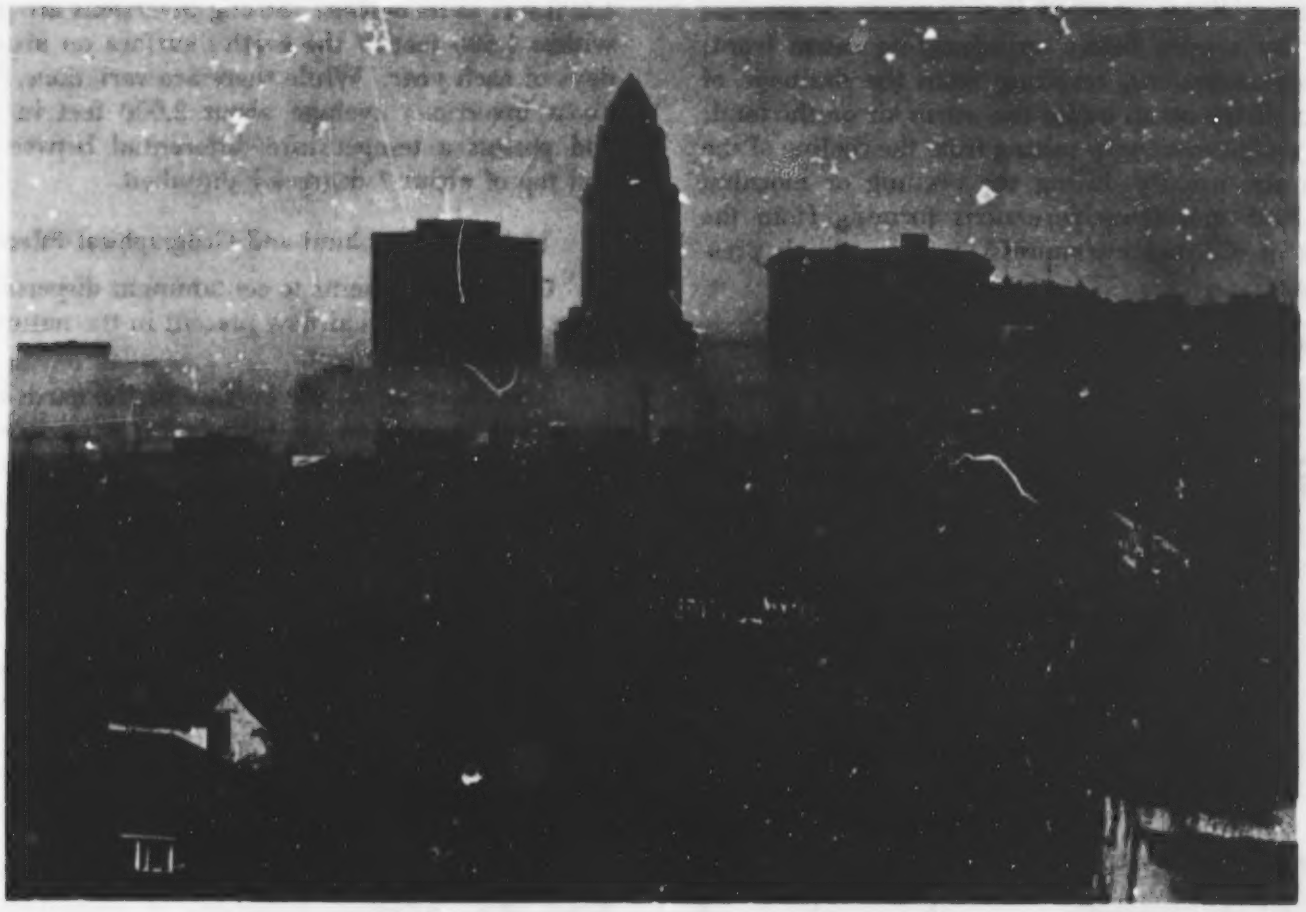


Figure I - 6. Appearance of smog during formation of low subsidence inversion over Los Angeles.

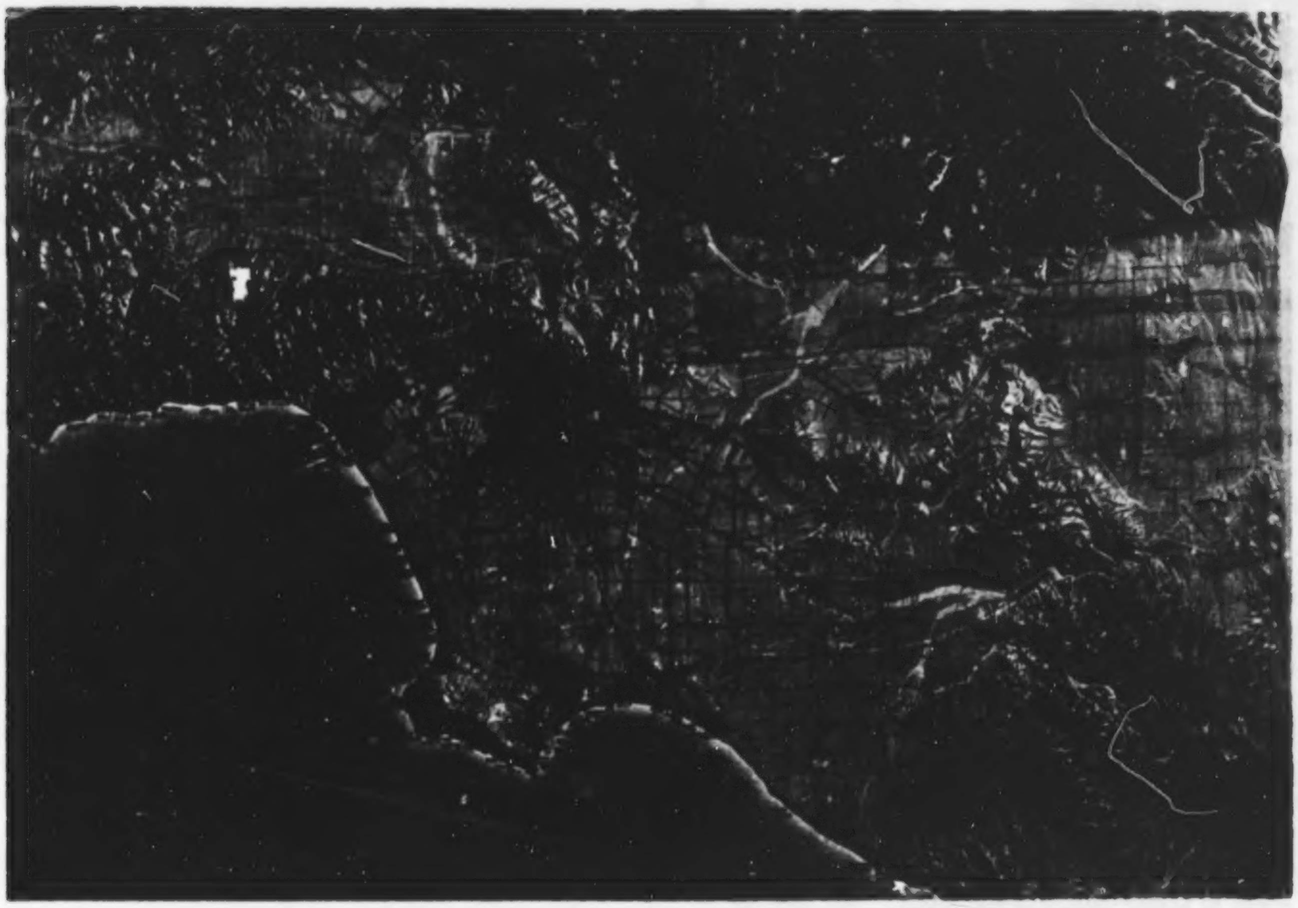


Figure I - 7. Topographical map of the Los Angeles County coastal basin.

coastal basin itself, including San Fernando and San Gabriel Valleys, gradually slopes towards the harbors and beaches fronting the Pacific Ocean.

The movement of sea and land breezes described for the Los Angeles Basin is somewhat typical for metropolitan basins in general, particularly on the west coasts of continents. The occurrence of both subsidence and radiational inversions below the mountains, particularly at the eastern portion of the ranges of the basin, are sufficient to effectively entrap pollutants, and may at times contribute to severe conditions in the foothill communities.

(c) Peninsulas and Inland Plains

Both peninsulas and inland plains present conditions which favor the dispersion of polluted air. In the case of the peninsula the surrounding bodies of water provide reservoirs of uncontaminated air for dilution. Stagnation of the air and temperature inversions, however, may still be effective in pollution retention when large air masses enveloping the peninsula become stabilized. Tall buildings, as in New York, may provide impediments to the horizontal motion of polluted air, and cause pollution to accumulate at street levels. Moreover, the absence of such natural barriers may contribute to the formation of a larger polluted air space, including many metropolitan communities. The waterways between New York and New Jersey, and between Detroit and Windsor at the United States and Canadian borders, contribute to the exchange of pollution from industry, metropolitan areas, ships and harbor installations, thereby complicating pollution problems.

3. The Parameters of Air Pollution

The parameters of the air pollution saturation potential are the meteorological dimensions of the volume of air available for dilution of contaminants each day, i.e. wind speed, the height of inversion base, and the maximum mixing height. At critical points in a smog episode, that volume may be expressed as the height to the inversion base times the area of the metropolitan area (see next section), and the number of air changes in the area.

On a monthly basis, the first basic parameter to be considered is the seasonal variations in local climate. Some climates, particularly in frigid continental areas, present a great variety of diurnal weather conditions, whereas others present conditions which are repetitive. The northern hemisphere, with its four seasons and rapid temperature and wind changes, exhibits sporadic incidents of air pollution attacks, rather than continuous pollution sieges. The subtropical climate of Southern California, on the other hand, presents two seasons — a summer or dry season — from June to November, and a winter or wet season — from December through May. The summer, particularly from October through November, constitutes the "smog" season. At that time the weather consists of light winds and calms with sustained subsidence inversion. The inversion layer frequently falls below 1,500 feet and the wind speeds are less than 3 miles per hour on the average.

Given the seasonal pattern of weather conditions, the intensity of the air pollution attack can be forecasted from synoptic data of the diurnal cycle of weather events. (These are usually supplied from the U. S. Weather Bureau). In Southern California, all of the pollution built up in the air space over a 24-hour period is usually dispersed from the air space during the same period. However, on occasion, air pollution may accumulate over a period of days, particularly during the wintertime.

Due to the great number of variables involved, the parameters can only be approached empirically, and are computed, like all weather forecasts, with a degree of probability, involving on occasion substantial statistical error. The science of micrometeorology, on which such forecasts must be based, is a relatively recent development. Each region must be studied in great detail, before accurate air pollution forecasts are possible.

Keeping in mind that air pollution effects may occur independently, forecasts should tend to be made of specific effects, rather than of a general condition. The Los Angeles County Air Pollution Control District forecasts four conditions involving several parameters. These are: (1) smog warning, (2) permission or prohibition of open burning, according to criteria established by Rule 57 of the APCD Rules and Regulations, (3) possible alerts resulting from high concentrations of key contaminants (ozone, oxides of nitrogen, sulfur dioxide, and carbon monoxide) set by Regulation VII of the Rules and Regulations, and (4) plant damage.

a. Smog Warning

For the purposes of the smog forecast (see Figure I-8), smog is defined in terms of visibility reduction and eye-irritation. A *smog warning* is issued to the public whenever a visibility of less than 3 miles (with humidity less than 50% in interior regions, and less than 60% in coastal regions) and/or moderate and heavy eye-irritation are forecasted for any area of the basin. These forecasts are based on past correlations of eye-irritation with weather data.

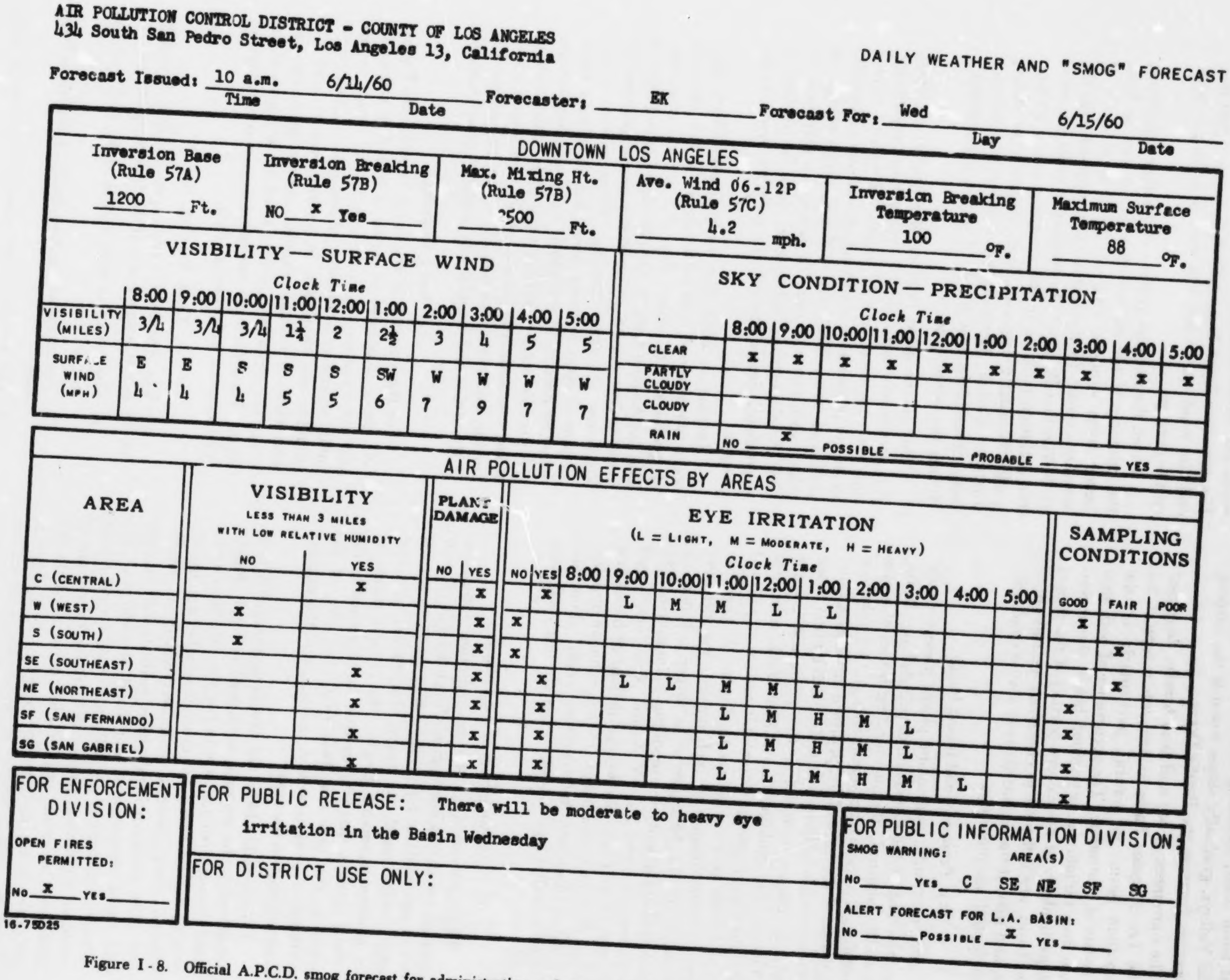
b. Open Burning, Rule 57

In Los Angeles County, open burning is prohibited by law whenever any of the following occurs:

a. The inversion base at 4:00 A.M. PST is 1,500 feet or less.

b. The maximum mixing height is less than 3,500 feet.

c. The average wind speed is less than 5 miles per hour.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 South San Pedro Street, Los Angeles 13, California

DAILY WEATHER AND "SMOG" FORECAST

Forecast Issued: 10 a.m. (Time) 6/14/60 (Date) Forecaster: EK Forecast For: Wed (Day) 6/15/60 (Date)

DOWNTOWN LOS ANGELES

Inversion Base (Rule 57A)	Inversion Breaking (Rule 57B)	Max. Mixing Ht. (Rule 57B)	Ave. Wind 06-12P (Rule 57C)	Inversion Breaking Temperature	Maximum Surface Temperature
1200 Ft.	NO x Yes	2500 Ft.	4.2 mph.	100 °F.	88 °F.

VISIBILITY — SURFACE WIND

Clock Time	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
VISIBILITY (MILES)	3/4	3/4	3/4	1¼	2	2½	3	4	5	5
SURFACE WIND (MPH)	E 4	E 4	S 4	S 5	S 5	SW 6	W 7	W 9	W 7	W 7

SKY CONDITION — PRECIPITATION

Clock Time	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
CLEAR	x	x	x	x	x	x	x	x	x	x
PARTLY CLOUDY										
CLOUDY										

RAIN NO x POSSIBLE ____ PROBABLE ____ YES ____

AIR POLLUTION EFFECTS BY AREAS

EYE IRRITATION (L = LIGHT, M = MODERATE, H = HEAVY)

AREA	VISIBILITY LESS THAN 3 MILES WITH LOW RELATIVE HUMIDITY		PLANT DAMAGE		EYE IRRITATION												SAMPLING CONDITIONS		
	NO	YES	NO	YES	NO	YES	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00	GOOD	FAIR	POOR
C (CENTRAL)		x		x		x		L	M	M	L	L					x		
W (WEST)	x			x	x													x	
S (SOUTH)	x			x	x													x	
SE (SOUTHEAST)		x		x		x		L	L	M	M	L					x		
NE (NORTHEAST)		x		x		x				L	M	H	M	L			x		
SF (SAN FERNANDO)		x		x		x				L	M	H	M	L			x		
SG (SAN GABRIEL)		x		x		x				L	L	M	H	M	L		x		

FOR ENFORCEMENT DIVISION:
OPEN FIRES PERMITTED:
No x YES ____

FOR PUBLIC RELEASE: There will be moderate to heavy eye irritation in the Basin Wednesday

FOR DISTRICT USE ONLY:

FOR PUBLIC INFORMATION DIVISION:
SMOG WARNING: AREA(s)
No ____ YES C SE NE SF SG
ALERT FORECAST FOR L.A. BASIN:
No ____ POSSIBLE x YES ____

16-75D25

Figure I-8. Official A.P.C.D. smog forecast for administrative, enforcement and research purposes, and for the notification of the general public.

These criteria come closest to the parameters of Los Angeles smog. They were designed to define those adverse smog conditions in which the additional loading of pollutants from open burning could not be tolerated. Although based on the best information available, they are not necessarily representative of all threshold pollution effects. Forecasts based on these parameters are good some 50% of the time, the error resulting from incomplete information with respect to such variables as the differences in wind averages between polluted and unpolluted masses of air, variations in height of the inversion layer during the day, and the total streamline pattern.

c. Possible Alerts

The Los Angeles County APCD calls alerts and takes appropriate action as defined by law whenever any of the concentrations of the key contaminants reaches alert proportions. The alert forecast is made in terms of (1) no alert forecast, (2) possible alert forecast, and (3) alert forecast (see Figure I - 8). Predictions of alert forecasts are predicated on adverse airflow patterns, severe lowering of the inversion base and maximum mixing height, low average wind speeds and a wide difference between the inversion breaking and maximum surface temperatures, and other factors. A progressively worsening condition is marked by values which increase in the following order: (1) plant damage, (2) visibility reduction, (3) eye-irritation, and (4) ozone concentration.

d. Plant Damage

The forecast of plant damage is based on the season in which sensitive crops begin to grow. The APCD always predicts plant damage when a smog warning is called, as conditions which obtain are sufficient to injure plants. It is not unusual for the APCD to predict plant damage in the spring on the basis of a forecast of light eye-irritation, even though smog is not forecast and approved open burning is permitted.

II THE METROPOLITAN POLLUTION ZONE

While the saturation potential of the air space is a fixed feature of the natural environment, the kinds and quantities of air contaminants emitted are a function of man-made factors. The saturation potential has meaning only with respect to the quantities and rates at which pollutants are emitted into the air space. A community with a greater saturation potential will tolerate less quantities of contaminants than a community with a lower saturation potential. It can be assumed, however, that every metropolitan air space has a saturation potential which can be realized by an increasing rate of emission. In this section, we shall be concerned with the capacity of the metropolitan economy of the pollution zone to pollute the air.

A. Definition of the Metropolitan Pollution Zone

A *pollution zone* is the geographical boundary of a continuous land area coterminous with areas affected by the flow of polluted air and in which both the sources and the effects of air pollution are concentrated. The pollution zone subsumes a relationship between cause and effect due to the movement of polluted air. The maximum boundary of the pollution zone is comprised of all areas from which the polluted air may originate and over which it may be effectively distributed. The pollution zone is, therefore, integrated from two basic types of land areas, either singly or in combination, 1) *source areas,* the areas containing the sources of air pollution, and 2) *effect areas,* those areas fumigated or otherwise affected by the flow of pollution.

Various possible juxtapositions of source and effect areas occur within the pollution zone. The source and effect areas may be individually homogeneous, but geographically opposed, or the source and effect areas may be mixed over the same land area. The relationship between the source area and the effect areas may be *direct* in that plumes from a source may fumigate areas immediately downwind, or *indirect* in that contaminants emitted from a source are diluted and stabilized in a whole smog mass before being distributed to effect areas.

The capacity of the metropolitan pollution zone to realize its saturation potential depends on the nature of the metropolitan economy and the source and population density. The nature of the economy determines the kinds and rates of contaminants emitted into the air, whereas the density of the sources of air pollution influences the concentrations these contaminants will reach in the air. A compact pollution zone with a high population density, of course, is one which is likely to present a severe air pollution problem, in addition to a profusion of public nuisances. Moreover, as the source density increases, the concentrations of non-reactive contaminants, such as carbon monoxide, increase proportionately, while the reactive contaminants are likely to create secondary contaminants whose concentrations tend to increase geometrically (see IV-B this Chapter).

The definition of the metropolitan pollution zone is of importance to the conduct of an air pollution control program for several reasons. First, the boundaries of the pollution zone must take into account the fact that a unified political and judicial system should possess the authority to regulate and control all sources of air pollution to alleviate all of the effect areas involved. Secondly, the pollution zone is postulated on preventing future problems as well as remedying existing problems, since the sources of air pollution, as well as the population affected, may grow in number and over a larger land area. Also, whenever certain effects of air pollution are known to exist, it is necessary to assume that other effects as yet unknown may also occur. Finally, the pollution zone must be viewed as a field of control operations to be physically approached by field personnel.

B. The Metropolitan Economy

The traditional city first developed either to (1) exploit a rich and abundant natural resource, such as coal, metals, petroleum or other mineral deposits or agricultural products located nearby, or (2) to capitalize on a commercial advantage due to proximity to trade routes — rivers, lakes, natural harbors and oceans. Cities which specialize in a single economic activity are known as *single economies*. Cities tend to develop *multiple* or diversified economies due to the tendency of a population to satisfy all of its needs in one place, and the growing technological and economic ramifications any single economy may present. All cities, of course, must develop the so-called *ubiquitous* industries — construction, printing and publishing, food processing, transportation, etc.(1) Cities may also develop to include a full range of industrial potentials.

The industrial revolution created the type of metropolitan community we live in today consisting of large, interdependent, industrial, commercial and transportation complexes, each of which possesses a permanent and growing air pollution potential. Two world wars and an interbellum period of economic rivalry accelerated the urbanization and industrialization of old and new cities, particularly with the advent of mass production techniques. The twentieth century subsequently witnessed a technological revolution in which not only unlimited production became possible, but industrial research and engineering development greatly expanded and diversified mechanical and chemical processing techniques. The air-contiminating activities ramified the chemical pollution possible and spread the sources of pollution throughout a broader economic base.

It is with the development of a chemical technology that the character of urban pollution changes from one of smoke from the combustion of coal to the subtle and aggressive effects resulting from the widespread emissions of a variety of sometimes invisible and highly reactive pollutants whose identities change in the atmosphere. These are chemical hazes or "smogs" which paradoxically, are associated with general prosperity, improved living and working conditions, advanced technology, and a consumer power which makes possible the increased use of automobiles, and other new sources of air pollution.

There is a tendency in modern times for cities to grow for reasons which cannot be attributed entirely to the presence of natural resources and historic trade routes due to the growing independence of technology from the traditional sources of power, and the need for more land to accommodate the population explosion. The growth of many cities in the southwest, for example, is based on the fact that industry has followed the movement of population to desirable areas. Thus, industrial and economic activity will locate where new markets and labor supplies present themselves. It can be anticipated that, on a world-wide basis, large cities may develop in subtropical and desert regions. Moreover, water transportation and hydroelectric sources of power, so long the necessity for community growth, may no longer be absolutely required as a result of the development of new forms of steam generating facilities and transportation systems.

The recent development of cities has also changed with respect to the relationship between local manufacturing and consumer economies. Early industrial economies maximized land areas for industrial and commercial uses, and where land became dear, cities centralized, built vertically, causing high concentrations of population and structures. Suburban or consumer oriented communities, on the other hand, first utilized land space to meet the demand for private dwellings, and all of the materials and appliances necessary to their construction, use, maintenance and repair, thereby creating large local markets for industry. The growth of suburbanized cities, while including industrialization, tends towards decentralization and lower population densities.

The centralization of industrial, commercial, transportation and residential activities tends to cause higher concentrations of air pollution. The decentralized community, on the other hand, may possess less concentrated source areas, but considering an equal population, may require a larger land area over which the sources become distributed. The decentralized community thus creates a larger pollution zone.

The decentralized community would present the ideal situation for air pollution prevention were it not for the fact that the tremendous use of automobiles which become necessary present high concentrations of exhaust contaminants throughout the pollution zone.* The incineration of rubbish and fuels used for domestic heating in private households, follows a similar pattern.

The type of air pollution problem which develops in a community reflects the nature of the economy and its level of technology. For the purpose of defining the metropolitan air pollution problem, the economy may be considered in three parts: (1) the fuel economy, (2) the industrial or manufacturing economy, and (3) the service or commercial economy.

1. The Fuel Economy

Since fuel is required to meet all the demands for space heating, power, electric generation, thermal processes, metal melting, transportation (automobiles,

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*In a large, highly decentralized community such as Los Angeles, mass rapid transportation systems pose a critical problem since the population densities are too low to support their financing and operation.

TABLE I - 2
COMPARATIVE POPULATION DENSITIES OF MAJOR U. S. CITIES
(Population per square mile(1))

CITY	YEAR	POPULATION	AREA SQ. MILES	POPULATION DENSITY
New York	1950-58(2)	8,010,000	315.5	25,000
Chicago	1950	3,620,962	207.5	17,540
Philadelphia	1950	2,071,605	127.2	16,235
Detroit	1950	1,849,568	139.6	13,200
Washington, D.C.	1950	802,178	61.4	13,064
Los Angeles City	1959(3)	2,406,000	450.9	5,344
Los Angeles County Basin	1959(4)	5,756,000	1200.0	4,800

(1) All statistics, except as noted, are from Bureau of the Census, *Statistical Abstracts of the United States*, U. S. Department of Commerce, 1958.

(2) As reported in the *World Almanac*, 1959, New York World Telegram and the Sun, New York, New York.

(3) January 1, 1959 estimate by the City Administrative Office, Los Angeles, California.

(4) April 1, 1959 estimate of the Regional Planning Commission, Los Angeles County. The Los Angeles County figure was actually reported as 6,059,161. An estimated 95% of this population lives in the Los Angeles County Basin. The area of Los Angeles County is 4,083 square miles.

ships, trains, buses, etc.), it is a primary source of all metropolitan air pollution problems.

Fuel economies fall into three basic categories: (1) solid fuels represented by coal, coke, wood and charcoal; (2) liquid fuels, represented by a wide range of petroleum derivatives including residual, kerosene and distillate fuels used for power plants and boilers, and motor fuels, such as gasoline and diesel oil in automotive transportation; and (3) gaseous fuels such as natural gas and liquefied petroleum gas. While the use of gasoline and diesel fuels is universal, the fuel used for industrial and power generating purposes is dependent upon the availability and cost of the fuels to the area.

Cities adjacent to coal deposits, typically found in the northern latitudes of the United States, are frequently referred to as coal economies, since coal is used for practically all combustion purposes, except transportation. The combustion of coal is most responsible for a type of air pollution consisting of carbon particles, smoke, sulfur dioxide and sootfall. Smoke emissions from coal, of course, have been controlled or prevented by several means. Highly volative bituminous or "soft" coal is replaced by the relatively smokeless anthracite and coke. Power plants and heating units are designed to provide enough time and temperature for complete combustion, in addition to the utilization of electrical precipitators and settling chambers. In the case of Pittsburgh, home owners are required to either use a smokeless grade of fuel or to install stokers or other heating units as will allow the smokeless combustion of fuels.

Petroleum economies are those which make use of liquid fuels for industrial power and domestic heating due to proximity to oil refineries. An area like Los Angeles, a major oil-producing and refining center, as well as one of the largest urbanized petroleum markets, is strictly a petroleum economy Even though a smoke problem from the combustion of fuel oil is not as pronounced in Los Angeles as it is in the coal-consuming economies, the widespread use of petroleum products is a major contributor to Los Angeles smog, particularly as a result of the combustion of more than 6,000,000 gallons of gasoline per day in internal combustion engines, and 60,000 barrels of fuel oil at steam generating and industrial facilities. The principal contaminants emitted from fuel oil are sulfur dioxide and oxides of nitrogen, whereas those produced from the combustion of gasoline are unsaturated hydrocarbons and oxides of nitrogen, both of which have a secondary pollution or smog-forming potential.

Although fuel economies based exclusively on the use of natural gas are rare, the use of natural gas is increasing, and both liquid and gaseous fuels tend to supplement each other and to supplant the use of solid fuels. Natural gas originates from the Utah, Colorado, New Mexico and Texas fields, and is piped to cities at great distances away. Of all of the fuels, natural gas, which consists of about 85% methane, 12% ethane and some inert materials, emits less contaminants, burns smokelessly, and variations in gas-air mixtures, and other mechanical factors involved in its combustion, are not as critical as with liquid and solid fuels. In Los Angeles County, the increasing availability of natural gas from the Texas fields has made it possible to require its use instead of fuel oil.

2. The Industrial Economy

The industrial economy of any metropolitan pollution zone consists of the types and number of manufacturing operations or processes employed in producing basic or by-product commodities from raw or salvaged materials, and the services necessary to maintain these industries. Industries tend to fall into standard categories,(26) whether all related processes are captive to one enterprise, or whether they are conducted individually on a contracting basis. From these industrial categories, it is possible to compare the kinds and extent of industrial activity of the various cities and to compute the air pollution potentials from each.

Each industry presents a certain type of air pollution problem in terms of the emission of smoke, fumes, mists, dusts, vapors or gases. The effluents derive directly from the materials employed in the manufacturing, the process methods used and their efficiency, the control measures taken, as well as the fuels used to provide mechanical or thermal energy.

Table I-3 lists the standard industrial categories, types of activities conducted and types of air pollution problems encountered. Metropolitan economies possessing a heavy concentration of any one industry tend to exhibit the types of air pollution problems associated with that industry, unless effectively controlled. A city with a diversified economy tends to possess a more varied type of air pollution problem. The extent of diversity and concentration may be given comparatively on the basis of employment figures. Although industries with relatively automated processes employ less persons, such as oil refineries, the presence of that industry may be sufficient to indicate its importance to air pollution. In such cases, figures can be given in throughput and output quantities of materials processed, as in Table I-5, page 25.

3. Service Industries

The service industries represent a vast variety of commercial, professional, governmental, military and educational activities, primarily of a non-manufacturing nature. These include:

Transportation and freight, including
  ships, automobiles, trucks, buses and trains.
Telecommunications.
Retail and wholesale trade.
Finance, insurance and real estate.
Hotels, motels and lodging places.
Medical services, clinics and hospitals.
Schools, colleges and universities.
Public administration and government facilities.
Repair services.
Laundry and cleaning.
Entertainment and motion pictures.
Salvaging and dumping.
Private households.

The services themselves do not, as a rule, constitute the air pollution potential. However, the shelters for such activities require space heating, disposal or incineration of combustible rubbish, and their occupants and supplies require transportation. Statistically, these comprise a mass of sources of air pollution spread throughout the pollution zone. In some instances these may constitute the principal sources of air pollution through the preponderance of their population. Air pollution thus can arise from a commercial and suburban economy, as well as from an industrial. When this happens, the entire pollution zone may be considered as both source and effect area.

Some service operations are similar to manufacturing type activities and may directly emit air contaminants. The extensive use of a variety of organic solvents, for example, in the application of protective coatings, dry cleaning and printing, as well as in a number of industrial operations such as degreasing and tire manufacturing, may result in the widespread emission of reactive air contaminants. Certain governmental operations, such as electric power generation, municipal incineration, sewage treatment and disposal, may constitute large single sources of air pollution. Salvage operations, particularly in the dismantling or separation of manufactured components, as in removing rubber coatings from wire and automobiles by torch or fire, may involve smoke and local nuisances.

C. *Industrial and Commercial Expansion and Diversification*

Because of phenomenal population increases everywhere, pollution zones change in size, population density, and technology. These changes lead to both gradual and spontaneous growths of the pollution potentials, factors which must be continuously surveyed by the control activity. There are several ways in which these potentials may increase.

a. Since population growth stimulates new markets in the economy, industrial growth follows. Industries relocating from other regions of the country will tend to bring with them their existing markets, thus greatly expanding the local economy. This factor of industrial growth may represent a sudden increase in the pollution potential of that industry.
b. As the market for any industry expands, existing plants expand their facilities with additional process equipment to meet new conditions of competition.
c. Dependent and subcontracting industries associated with the industry expand to help maintain that industry as well as to help distribute its products.
d. Plant expansion tends to offset gains made by existing control techniques and in time pollution potentials may be brought back to precontrol levels. This *growth factor* will thus increase the level of pollution despite control efforts. In order to decrease it, the average control efficiency must be raised.
e. Changes in industrial operations, materials, and fuels or the introduction of novel processes may cause new air pollution problems. The manufacture of products employing radiational derivatives may emit radioactive contaminants whose presence in the air may not be tolerated.

TABLE I - 3
STANDARD MANUFACTURING INDUSTRIES OF THE METROPOLITAN ECONOMY

(Based on Reference 26)

MANUFACTURING INDUSTRY	NATURE OF ACTIVITY	TYPES OF AIR POLLUTION PROBLEM	NUMBER EMPLOYED IN LOS ANGELES COUNTY*
PRIMARY METALS (Ferrous and non-ferrous)	*Primary smelting*** of ore to obtain metallic elements. *Steel Mills*—manufacture of steel alloy products by removal of graphitic carbon from iron and addition of alloy elements. *Ferrous and nonferrous foundries*—cast products from sand or permanent molds. *Secondary smelting* — separates ingots of each element from scrap. *Secondary ingot production* - prepares alloyed ingots from scrap.	Primarily fuming of metallic oxides, and emission of CO, smoke, dust and ash from melting operation, depending on the volatility and impurities of the metals, scrap or ore concentration. Smelting is most notorious, emitting sulfur dioxide, lead and arsenical copper fume, depending on metal smelted.	23,100
FABRICATED METAL PRODUCTS	Manufacture of a large variety of products: Heating and plumbing equipment, tools and hardware, structural metal products, cutlery, metal stamping and coating, lighting fixtures, tin cans and others. Usually involves metal melting from ingot; machine shops, metal finishing and surface coating.	Metals melted are usually refined, and melting operations are easily controlled. Principal air contaminants are metallic fumes and dusts from foundries and solvent mists and vapors from application of protective coatings in finishing departments.	55,700
MACHINERY	Machining and finishing of component machinery parts and/or their assembly in the production of a wide variety of mechanical equipment (but not including electrical machinery). Farm implements, machine tools, printing, office and store equipment, oil field production and refinery equipment, textile, shoes and clothing equipment, construction equipment, household equipment, etc.	Primarily dusts and mists from finishing departments, some smoke and fumes from quenching in tempering and heat treating. Metal melting is not usually involved.	61,300
ELECTRICAL MACHINERY	Manufacturing and assembly of machinery; apparatus and supplies for the generation, storage, transmission, and utilization of electrical energy, principally electrical motors and generators.	Air contaminants similar to those described under machinery.	74,400

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* As reported by the California State Department of Employment, January 1959.

** No primary smelting activity is conducted in Los Angeles County. Smelters have caused adverse air pollution conditions and damage to vegetation, crops or animals in Ducktown, Tennesse; Anaconda, Montana; Salt Lake City, Utah and Trail, British Columbia. These operations are now controlled.

TABLE I - 3 *(continued)*

MANUFACTURING INDUSTRY	NATURE OF ACTIVITY	TYPES OF AIR POLLUTION PROBLEM	NUMBER EMPLOYED IN LOS ANGELES COUNTY*
MINING***	Quarrying and milling of solid products and minerals — coal, iron and metallic ore.	Waste explosive gases, CO, etc., dusts and fumes.	
	Petroleum and petroleum refining. Drilling and extraction of crude petroleum from oil fields, recovery of oil from oil sands and oil shale, and production of natural gasoline and cycle condensate. Oil refining consists of a number of complex flow processes based on heat and pressure which crack, build up, alter or segregate hydrocarbons from crude oil in the production of a large variety of commercial products from high octane gasolines to heavy oils and greases. Natural gas originates from the oil fields in the southwest.	Due to the large number of production steps, all forms of air pollution arise from refineries. These include vapors from evaporation of petroleum products in handling and storage; sulfur dioxide and smoke plumes from scavenging and burning of refinery fuels in heating equipment; odors, mists and dusts from cracking operations.	19,900
FURNITURE, LUMBER AND WOOD PRODUCTS	Logging and milling, including veneering, planing, and plywood manufacturing; boxing and container manufacturing; sawdust and other by-product manufacturing. Furniture mfg., household, office and store fixtures. Involves production wood working, (planing, milling, cutting, sanding, shaping, etc.), finishing (staining, priming, painting, etc.) and occasionally elimination of large volume production wastes by burning.	Fines and dusts from milling operations. Paint and solvent emissions from surface coating. Smoke from burning waste lumber, mill ends, fines and sawdust.	28,300
TRANSPORTATION EQUIPMENT	Manufacture and/or assembly of component parts for ships, automobiles, rolling stock, aircraft and other transportation equipment involving fabrication of structural assemblies and components, and, in the case of ships and rolling stock, riveting, welding and sheet metal work. A high degree of specialization, especially in automobiles and aircraft, necessitates extensive subcontracting activities, or concentration of many captive industries into coordinated production systems.	Aside from assembly lines which are not in themselves significant sources of air pollution, captive subsidiary operations may involve foundries, heat treating, wood-working, plating, anodizing, chem-milling and surface coating operations which contribute all types of air contaminants including organic vapor emissions from the application, drying and baking of protective coatings.	225,700****

*** American mining locations are not as a rule distributed among urban areas. In Los Angeles County, only petroleum refining is significant as a mining activity.

**** 27,400 motor vehicles and equipment; 188,400 aircraft and parts, 9,900 ships and boats.

TABLE I - 3 (*continued*)

MANUFACTURING INDUSTRY	NATURE OF ACTIVITY	TYPES OF AIR POLLUTION PROBLEM	NUMBER EMPLOYED IN LOS ANGELES COUNTY*
CHEMICALS AND ALLIED PRODUCTS	Manufacture of almost an unlimited variety of products: petro-chemicals, heavy or industrial chemicals such as sulfuric acid, soda ash, caustic soda, chlorine and ammonia; pharmaceuticals, pesticides, products of nuclear fission, plastics, cosmetics, soaps, synthetic fibers, such as nylon, pigments, etc. Manufacturing techniques encompass virtually the entire chemical technology.	Chemical technology makes possible all forms of pollution, involving the emissions of the chemicals (both chemical and end-product) and the derivative or reaction products of the chemicals in process or in the atmosphere.	22,100
MINERALS (Stone, Clay and Glass Products)	Manufacture from earth materials (stone, clay and sand), glass, cement, clay products, pottery, concrete and gypsum products, cut stone products, abrasive and asbestos products, roofing materials, bricks, etc., involving mechanical processes such as crushing, mixing, classifying and grading; batching, drying and baking in kilns to vitrify dishware, and melting and forming to produce glass products.	Dusts from mechanical processes, smoke and fumes from melting or kiln operations.	19,000
TEXTILE	Includes milling and manufacturing of yarns, threads, braids, twines, fabrics, rugs, apparel, lace, and a vast variety of products involving processes of spinning, spooling, winding, weaving, braiding, knitting, sewing, bleaching, dyeing, printing, impregnating, batting, padding, etc.	Lint and fines are emitted from production wastes; organic vapor emissions or other mists from dyeing, bleaching, impregnating, cleaning; smoke from combustion equipment required to power weaves, looms, and other processing and conveyor equipment.	48,900
RUBBER PRODUCTS	Manufacture from natural, synthetic, or reclaimed rubber (gutta percha, balata, or gutta siak), rubber products such as tires, rubber footwear, mechanical rubber goods, heels and soles, flooring, and other rubber products. Processes involve mastication, mixing or blending of crude rubber, reclaim or chemical rubbers, calendering, tubing, binding and cementing, curing, etc.	Local dusts and carbon black emissions from mixing and rolling operations, but usually under careful control. Organic vapor emissions from solvents used in bonding and cementing, coating and drying of products.	15,400

TABLE I - 3 *(continued)*

MANUFACTURING INDUSTRY	NATURE OF ACTIVITY	TYPES OF AIR POLLUTION PROBLEM	NUMBER EMPLOYED IN LOS ANGELES COUNTY*
PAPER AND ALLIED PRODUCTS	Manufacture of paper and paper products from wood pulp, cellulose fibers, and rags involving cutting, crushing, mixing, cooking, and paper mills.	Some possible sawdust emissions, but otherwise practically no emissions, except from combustion equipment to provide steam heat and power for mechanical equipment. Construction materials such as roofing paper involve saturating paper with asphalt and impregnating with minerals, causing mist and dust problems.	12,100
PRINTING AND PUBLISHING	Printing and publishing by means of letterpress, lithography, gravure, or screen, bookbinding, typesetting, engraving, photoengraving, and electrotyping. Involves lead melting pots for typesetting machines, and significant quantities of inks containing organic solvents.	Lead oxide emissions are possible from lead pots, but these are easily controlled. Organic solvent emissions arise from the large volume of inks, particularly in rotogravure processes.	34,600
INSTRUMENTS	Manufacture and assembly of mechanical, electrical and chemical instruments for dental, laboratory, research and photographic uses, including watches and clocks. Involves casting and machining of a variety of hard metal alloys, including brass and steel; assembly, plating and finishing.	Emissions from these plants are usually controlled, but can involve smokes, dusts, and fumes similar to those of fabricating and machinery manufacturing industries. Hard-chrome electrolytic plating is usually involved with high quality instrumentation, causing emission of acid mists.	14,600
FOOD AND KINDRED PRODUCTS	Includes the slaughtering of animals and the curing and smoking of meat products as well as the preparation of all other foods such as dairy products, canning and preserving of fruits, vegetables and seafoods; grain and feed milling, baking, preparation of beverages, including coffee, beer and other alcohols; animal rendering, manufacture of fats, oil, grease, tallow, etc.	Most notably odors, particularly from rendering operations and from poor housekeeping where products are permitted to decompose. Odors may also occur from the handling of by-products, and from coffee roasting. Dust from grain and feed mill operations.	46,900
OTHER MANFUACTURING INDUSTRIES	Tobacco, ordnance and armaments, leather and leather products, building construction, jewelry and silverware, etc.	All types of air pollution arising from basic processes described in the foregoing.	38,800

New petroleum refining techniques may create products with higher vapor pressures and greater quantities of unstable compounds. Similarly, slight alterations of basic fuels can result in a sudden increase of air contaminants. By fractionally increasing the sulfur content in gasoline or other fuels in mass use, for example, the visibility reduction resulting from increasing quantities of aerosols in the atmosphere may be increased several hundredfold.

f. With the expansion of both industry and the population, power requirements increase quite sharply. The increased use of fuels is not only influenced by the growth factor but also by a higher standard of living, creating a demand for more appliances utilizing greater amounts of electrical energy.

D. *The Los Angeles Metropolitan Pollution Zone*

Los Angeles County covers 4,083 square miles and includes 71 separately incorporated cities as well as large unincorporated areas (Figure I-9). The area is topographically divided by the Sierra Madre mountain range into two sections. The southern section, the Los Angeles County coastal basin proper, comprises some 1200 square miles and virtually the entire metropolitan area of Los Angeles County. The second, or northern section, includes the mountain ranges, and the sparsely populated desert regions of the Antelope Valley.

The boundaries of the pollution zone tend to coincide with the Los Angeles Basin.* The north-south dimension of the zone from the mountain ranges to the coast lines provides a clear definition of the zone's breadth. The pollution zone also extends along the coastal strips north of Santa Monica and the mountain passes and out-bound routes just north and west of the San Fernando Valley.

The pollution zone is less defined at the Los Angeles-Orange-San Bernardino County lines where both wind flow and metropolitan areas overlap causing some exchange of pollution among the bordering counties. The actual boundary of the Southern California Pollution Zone should probably be extended to include the expanding and merging metropolitan complexes to a point south of San Diego, if not to the Mexican border. It may also extend in the foreseeable future through the mountain passes and coastal strips north to Santa Barbara and Bakersfield**.

The metropolitan area has grown by increments in land area in all directions, rather than through concentrations of tall buildings. The effect of such development has resulted in the encroachment of industrial and residential communities onto each other's areas. Agricultural areas, for example, have been replaced by industrial establishments or housing developments. Refineries and industries previously located in relatively uninhabited areas are being surrounded by residential communities, thus increasing the number of incidents of public nuisance. The metropolitan complex itself continues across county boundaries. With the complete saturation of the land area, taller buildings are expected to be constructed.

1. The Los Angeles Economy

Prior to 1940, the Los Angeles economy consisted of a number of industries which depended on the climate of the area and the availability of relatively cheap land. These were the nucleus of an aircraft industry (favorable year-round flying conditions), citrus products (the county was one of the richest agricultural areas in the United States), motion picture industry (all-year sunshine for camera illumination), retail trade (encouraged by tourism and retired citizens), and a resort area (access to beaches and mountains). In addition, the area contained abundant petroleum resources for oil-field development and refining, and excellent harbor facilities in the Long Beach-Wilmington-San Pedro areas.

During World War II all industries developed phenomenally, particularly in aircraft and ship building, while Los Angeles became an important military center. Thousands of civilians and military personnel residing in or passing through the area eventually decided to live in Southern California after the war.

The population movement to Southern California since World War II never ceased, and Los Angeles has grown from 2¾ million in 1940 to more than 6 million in 1960. Aircraft, missiles and subsidiary industries also continued to grow during the post-war period. Established industries expanded their facilities, and new industries were created to meet market demands, while industries in other parts of the country either developed subsidiary or west coast divisions, or moved their home offices entirely. Due to the local demand for automobiles, automobile and other assembly plants were established in the area. A diversified and self-sustaining economy developed which grew from 6,000

TABLE I-4
GROWTH OF LOS ANGELES COUNTY

Year	Population	Registered Vehicles	Gasoline Consumption Gal/Day	Industries
1940	2,785,643	1,220,361	1,920,000	5,900
1950	4,151,687	2,007,552	3,850,000	11,500
1960	6,120,000	3,450,000	6,400,000	17,000
1970	8.050,000	4,900,000	9.100,000	21,000
1980	9,980,000	6,350,000	11,780,000	25,000

Source: Reference 6.

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* The jurisdiction of the Los Angeles County Air Pollution Control District, however, includes the entire County of Los Angeles.

** On the east coast there is a growing awareness of pollution of a national air space extending from metropolitan New York and New Jersey south through Washington, D.C.

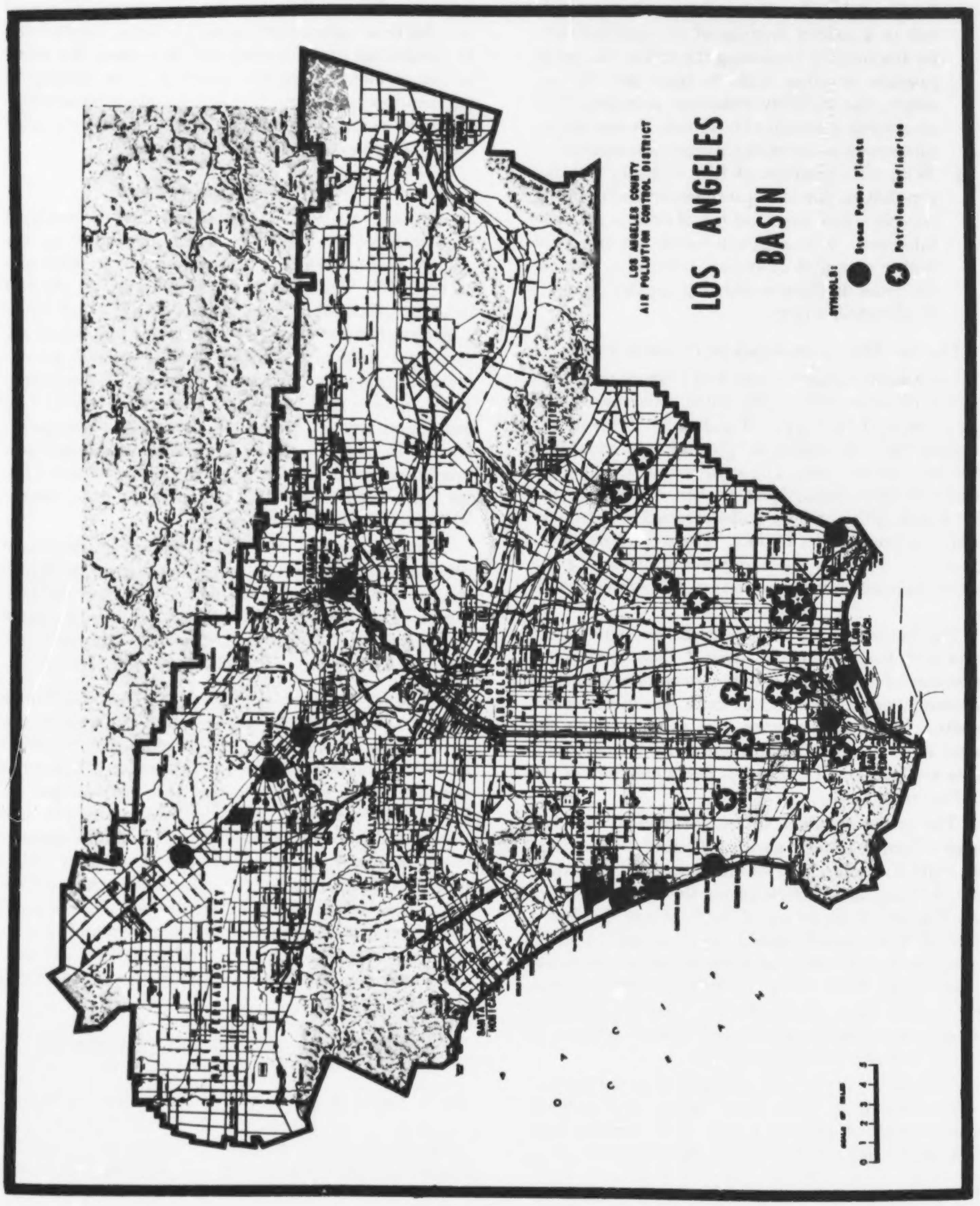

Figure I-9. The boundaries of the Los Angeles Basin, as legally defined by the Rules and Regulations of the A.P.C.D.

industrial establishments in 1939 to more than 17,000 in 1960. Los Angeles County, consequently, developed as the largest heavily industrialized semi-tropical area in the world, as well as the third largest metropolitan area in the United States.

The petroleum industry, which grew to satisfy a market which developed virtually on its own doorsteps, now accounts for about 10% of the national refining capacity and is concentrated in some 19 refineries with a crude oil processing capacity of approximately 750,000 barrels, and a finished gasoline product of about 16 million gallons per day. The extent of the other industrial activities conducted in Los Angeles, as shown from the employment figures in Table I-3, indicates the degree of industrial diversity in Los Angeles County.

TABLE I - 5
CURRENT STATISTICS
FOR LOS ANGELES COUNTY

ITEM	QUANTITY
Population	5,830,000
Total employees in manufacturing	740,000
Gasoline powered vehicles registration	2,920,000
Diesel powered vehicle registration	9,000
Gasoline consumed by vehicles	5,820,000 gal/day
Diesel fuel consumed by vehicles	100,000 gal/day
Fuel oil consumed by industrial combustion sources	1,900,000 gal/day(a)
Natural gas consumed by industrial combustion sources	3,200,000 gal/day(a), (b)
Refinery gas consumed by industrial combustion sources	1,600,000 gal/day(b)
Fuel oil consumed by domestic and commercial combustion sources	200,000 gal/day(b)
Natural gas consumed by domestic and commercial combustion sources	3,300,000 gal/day(a), (b)
Solvents used for all purposes	1,000,000 lbs/day
Refinery crude oil throughput	650,000 bbls/day

(a) Prior to Rule 62.
(b) Equivalent gas/day on a Btu basis.

Source: Reference 7.

The industrial and steam-generating fuel requirements in Los Angeles County are met entirely by fuel oil and natural gas. The increasing demand for fuel has severely taxed available fuel supplies, particularly natural gas, and is one of the major factors to be considered in the Los Angeles problem.. Prior to 1940, a majority of the power was supplied by Hoover Dam, but since that time excess demand has been met by the construction of some 11 steam-electric power generating stations located throughout the Basin (see Figure I-9).

Due to the severe meteorological conditions in Los Angeles County, the extensive use of fuel oil is being replaced by natural gas which is conveyed by pipline from Texas. Gas supplies are available in sufficient quantities to meet current needs during the seven months of the smog season, as required by District Rule. Population increases, however, continue to increase this demand.

The spread of a large population over such an extensive land area has caused an unprecedented increase in traffic population, some 3,000,000 registered motor vehicles consuming almost 6,000,000 gallons per day of gasoline — the largest metropolitan concentration of automobiles in the world.

TABLE 1 - 6
EFFECTS OF POPULATION AND INDUSTRIAL GROWTH IN LOS ANGELES COUNTY ON STEAM-ELECTRIC POWER PRODUCTION AND FUEL REQUIREMENTS AND COMPARISON OF CONTAMINANT EMISSIONS FROM THE BURNING OF FUEL OIL AND NATURAL GAS EQUIVALENT OF FUEL OIL(a)

YEAR	POPULATION (MILLIONS)	TOTAL POWER REQUIREMENT (BILLION KILOWATT-HOURS PER YEAR)	STEAM-ELECTRIC POWER PRODUCTION (BILLION KILOWATT-HOURS PER YEAR)	FUEL REQUIRED FOR POWER PRODUCTION (THOUSAND EQUIVALENT BARRELS PER DAY)	SULFUR DIOXIDE EMISSIONS FROM FUEL OIL (TONS PER DAY)
1950	4.2	8	4.5	20	105
1958	5.6	24	15	60	320
1970	8	66	43	190	1020

YEAR	SULFUR DIOXIDE EMISSIONS FROM NATURAL GAS (TONS PER DAY)	NITROGEN OXIDE EMISSIONS FROM FUEL OIL (TONS PER DAY)	NITROGEN OXIDE EMISSIONS FROM NATURAL GAS (TONS PER DAY)	AEROSOL EMISSIONS FROM FUEL OIL (TONS PER DAY)	AEROSOL EMISSIONS FROM NATURAL GAS (TONS PER DAY)
1950	0.02	60	40	10	1
1958	0.1	185	120	30	3
1970	0.2	570	380	95	10

(a) Los Angeles County Air Pollution Control District Fuel Survey; Tulin, R. S., Fuel Requirement and Supply—Liquid Petroleum and Natural Gas, District V — Los Angeles Basin; Twenty-Eighth Annual Report — Utilities — Los Angeles Area, 1957-1958 Los Angeles Chamber of Commerce.

Source: Reference 6.

Prior to October 1956, 11,000 tons of domestic, commercial and industrial wastes were disposed in some one-and-a-half million inefficient single-chamber incinerators and open fires, thus causing an important smoke problem. Since that time, rubbish burning has been eliminated by rule, except in a relatively few instances where approved multiple-chamber incinerators are permitted. Open fires, with a few exceptions, are also illegal in the Los Angeles Basin.

At the present time, most combustible refuse is buried in land-fill dumps, and the remainder is burned in municipal incinerators or approved multiple-chamber incinerators capable of smokeless combustion. Like fuel burning, rubbish disposal is a more or less permanently constituted problem, involving either the availability of dump sites, which becomes reduced by population growth, or the construction of municipal incinerators which, while more efficient than single-chamber incinerators collectively, still contribute to air pollution.

IV POLLUTION POTENTIALS OF THE METROPOLITAN ECONOMY

Due to the diversity and complexity of the sources of air pollution, the atmospheres of large cities contain most of the chemical substances and their derivatives or oxidation products known to chemical technology, including, perhaps, many that are unknown. To determine what is in the air, it is necessary to investigate the types and quantities of pollutants emitted, the activities responsible for their emission, and the relative contributions to the major classification of air contaminants. These involve both the sampling of the air to identify and measure the contaminants present and an analysis of the air pollution potential of the metropolitan economy. The *air pollution potential*, which we shall now consider, is divided in three parts: the *primary potential* of metropolitan activities to emit contaminants; the *secondary potential* of the contaminants to produce other contaminants in the atmosphere through chemical reaction; and the *nuisance* potentials of individual sources of pollution.

A. The Primary Potentials

The primary pollution potentials may be said to represent the kinds of contaminants and the rates at which they are emitted from the sources of air pollution prior to any interaction or to modifications as a result of natural forces in the atmosphere. Computation of the primary potentials involves (1) classification of the important air contaminants emitted from the activities of the metropolitan economy, (2) determination of the average rates at which they are emitted from the respective activities, i.e., the *emission factors*, (3) a survey of the quantities of materials handled, processed or burned by the economy, and (4) computation of the pollution potentials in weight-units per day.

1. Classification of Primary Air Contaminants

Because some contaminants predominate in the atmospheres of some cities, and not in others, the classifications are oriented towards the significant effect-producing contaminants. Generally, such classifications first distinguish between the two physical states of contaminants — aerosols and gases (organic and inorganic), then the major chemical families or classes, and finally the subgroupings of each family, if not the actual names of the specific chemical compounds. The more important the contaminant, the more specifically is it identified. Table I - 7 illustrates, for example, the classification of air contaminants found in the Los Angeles atmosphere.

2. Emission Factors

The *emission factor* is a statistical average of the rate at which contaminants are emitted from the processing, handling or burning of given quantities of material. It is determined by measuring the quantity and composition of the effluent by representative source testing and evaluating the material and fuel specifications reported by the sources of air pollution and the technical literature. For example, assuming no control process is employed, the emission factors for oxides of sulfur (estimated as SO_2) from tests and past experience are as follows(5):

Fuel oil combustion — 30 pounds per 1,000 pounds of oil.
Coal burning — 40 pounds per ton of coal.
Automobile engines — 17 pounds per 1,000 gallons of gasoline.
Diesel engines — 15 pounds per 1,000 gallons of fuel.

TABLE 1 - 7
CLASSES OF CONTAMINANTS FOUND IN THE LOS ANGELES ATMOSPHERE

MAJOR CLASSES OF AIR CONTAMINANTS	SUBCLASSES OF AIR CONTAMINANTS	TYPICAL MEMBERS OF SUBCLASSES
Organic Gases	Hydrocarbons	Hexane, Benzene Ethylene, Methane Butane, Butadiene
	Aldehydes and Ketones	Formaldehyde, Acetone
	Other Organics	Chlorinated Hydrocarbons, Alcohols
Inorganic Gases	Oxides of Nitrogen	Nitrogen Dioxide, Nitric Oxide
	Oxides of Sulfur	Sulfur Dioxide Sulfur Trioxide
	Carbon Monoxide	Carbon Monoxide
	Other Inorganics	Hydrogen Sulfide, Ammonia, Chlorine
Aerosols	Solid Particulate Matter	Dusts, Smoke, Fumes
	Liquid Particulate	Oil Mists, Entrained Liquid Droplets

Source: Reference 7.

Tables I - 8 through I - 12 show the emission factors for the major contributors to those classes of contaminants which are significant in Los Angeles. Although these emission factors represent the best available data, they are subject to continuously changing conditions. Emission factors, moreover, cannot be satisfactorily generalized for the nation as a whole, but must be computed for each specific pollution zone. Such factors as materials used, processing techniques and efficiency, etc. as practiced locally affect the final estimates.

TABLE I - 8

EMISSION FACTORS FOR AIR CONTAMINANTS DISCHARGED FROM THE COMBUSTION OF FUELS IN STATIONARY SOURCES

LOCATION OF STATIONARY COMBUSTION SOURCE	EMISSION FACTORS, POUNDS PER THOUSAND EQUIVALENT BARRELS OF FUEL OIL BURNED(a)							
	Hydrocarbons	Aldehydes and Ketones	Other Organic Gases	Oxides of Nitrogen	Sulfur Dioxide	Carbon Monoxide	Other Inorganic Gases	Aerosols
Power Plants								
Gaseous Fuels	n	6	18	2340	2.5	n	n	90
Liquid Fuels	33.9	24.9	114.2	5000	11,000	1.79	n	893
Refineries								
Gaseous Fuels(b)	156	18	84	1009	2.5(c)	25	n	126
Liquid Fuels	146	26.8	473	3200	12,200	n	n	821
Other Industries								
Gaseous Fuels	n	12	30	1283	2.5	2.4	n	105
Liquid Fuels	31.6	25	70.6	3360	10,710	6.25	n	839
Domestic and Commercial								
Gaseous Fuels	n	n	n	696	2.5	2.4	n	112
Liquid Fuels	27.9	22.1	62.2	3060	4,725	n	n	593

n — Negligible, traces only.

(a) 6000 cubic feet of gas is equivalent to one barrel of fuel oil.

(b) Applicable to emissions from the burning of natural gas and refinery make gas.

(c) Applicable only to natural gas. Sulfur dioxide emissions from the combustion of refinery make gas are dependent upon the amount of hydrogen sulfide removal accomplished prior to burning.

Source: Originally appeared in reference 7; estimates revised, 1-30-61.

TABLE I-9

EMISSION FACTORS FOR AEROSOLS FROM METALLURGIC AND MINERAL PROCESSING OPERATIONS IN LOS ANGELES COUNTY

SOURCE	*Aerosol Emission Factor, Pounds per ton of Raw Material Processed*	
	UNCONTROLLED	CONTROLLED
Hot Asphaltic Concrete Plants	5	0.45
Perlite and Vermiculite Furnaces	21-88	—
Glass Furnaces (recuperative)	3.4	—
Frit Manufacturing Furnaces	9.4	0.19
Open Hearth Steel Furnaces (58-ton capacity) (a)	17.8	0.36
Grey Iron Melting Cupolas (avg.)	17.1	0.26
Less than 48" I.D.	12.9	—
48-60" I.D.	19.5	—
Greater than 60" I.D.	18.9	—
Electric Steel Melting Furnaces (avg.)	8.6	0.17
Less than 5-ton capacity	10.6	—
5-20 ton capacity	5.7	—
50-75 ton capacity	9.6	—
Melting of Red Brass:		
Crucible or Pot Furnaces	3.3	—
Rotary Furnaces	21.3	10.1(b)
Reverberatory Furnaces	16.8	—
Electric Furnaces	3	—
Melting of Yellow Brass:		
Crucible Furnaces	14	5.1(b)
Rotary Furnaces	—	22.8(b)
Reverberatory Furnaces	—	5.7(c)
Electric Induction Type Furnaces	0.7	—
Melting of Bronze:		
Crucible Furnaces	3.8	—
Rotary Furnaces	30.6	4.7
Melting of Aluminum:		
Crucible Furnaces	1.9	—
Reverberatory Furnaces	5.2	2.1

(a) Principally scrap remelt.

(b) Using slag cover as the only control method.

(c) With baghouse control.

Source: *Reference 7.*

TABLE I-10

HYDROCARBON EMISSION FACTORS FOR PETROLEUM REFINING SOURCES

SOURCES OF EMISSION	*Hydrocarbon Emission Factors — Pounds per 1000 Barrels Crude*	
	UNCONTROLLED	CONTROLLED
Crude Oil Storage	500	75(a)
Petroleum Distillate Storage	670	100(a)
Fluid Catalytic Cracking	200	12(b)
Thermofor Catalytic Cracking	50	—
Separators	270	8
Valves and Flanges	28	—
Pump Seals	125(c)	20(d)
Relief Valves	60	5
Loading Racks	150(e)	2(e)
Vacuum Jets	150	0(f)
Blowdowns, Turnarounds, Vessel and Tank Maintenance	25	5
Treating	8	2
Cooling Towers	6(g)	—
Compressor Exhausts	1(h)	—
Miscellaneous	50	12

(a) Floating roof controls. For vapor recovery, factor would theoretically be zero.

(b) Controlled by carbon monoxide waste heat boiler.

(c) Mostly packed gland seals.

(d) Mechanical seals for light hydrocarbon service.

(e) Pounds per 1000 barrels loaded.

(f) Controlled by condensation and incineration of non-condensables.

(g) Pounds per 1,000,000 gallons of cooling water.

(h) Pounds per 1000 c.f. of gas burned.

Source: *Reference 7.*

TABLE I-11

AVERAGE EMISSION FACTORS FOR AIR CONTAMINANTS DISCHARGED FROM AUTOMOBILES IN LOS ANGELES COUNTY PER 1,000 GALLONS (a) (b)

Contaminant	*Emission Factor*
Carbon Monoxide	3000
Organic Vapors	200-400
Oxides of Nitrogen	50-150
Aldehydes	5
Sulfur Compounds	5-10
Organic Acids	2
Ammonia	2
Solids (Zinc, lead, other metallic oxides and carbon)	0.3

(a) Although these emission factors are subject to a number of engine, fuel and operating variables, they may be considered to be reasonable average conditions.

(b) Chambers, Leslie A., *Automotive Vehicles as Air Pollution Sources*, National Conference on Air Pollution, Washington, D.C., November, 1958. Estimates revised January 1961; subject to change pending further investigation.

TABLE I - 12

AVERAGE EMISSION FACTORS FOR AIR CONTAMINANTS FROM BURNING COMBUSTIBLE REFUSE IN OPEN FIRES (a) AND SINGLE-CHAMBER INCINERATORS PRIOR (b) TO BAN, IN POUNDS PER TON BURNED(c)

CONTAMINANT	EMISSION FACTOR
Hydrocarbons	6
Aldehydes and Ketones	10
Other Organic Gases	8
Oxides of Nitrogen	4
Sulfur Dioxide	3
Carbon Monoxide	40
Other Inorganic Gases	n
Aerosols	22

n Negligible, traces only.

(a) Rule 57 of the Rules and Regulations of the Los Angeles County Air Pollution Control District prohibits the burning of combustible refuse in the Los Angeles Basin after September 30, 1957 except for certain acts of fire hazard prevention, fire fighting training and agricultural operations.

(b) Rule 58 of the Rules and Regulations of the Los Angeles County Air Pollution Control District prohibits the burning of combustible refuse in any incinerator within the Los Angeles Basin except in an approved multiple-chamber incinerator or its equivalent.

(c) Emission factors used in total emissions computed in reference 7..

3. Surveys of Materials Processed and Fuels Burned

Realistic estimates of the quantities and composition of materials handled or processed in metropolitan activities are summarized from data supplied by surveys, questionnaires, registration and inspection of the sources of air pollution, chambers of commerce, governmental agencies, research organizations, scientific publications, etc. and from a statistical analysis of the activity and growth of the metropolitan economy.

4. Computing the Primary Potentials

In determining the total pollution potential of each activity, the amount of material processed per day is multiplied by the emission factor. Table I-13 summarizes the primary pollution potentials of the Los Angeles economy for 1960. From these estimations, the total daily primary potentials include 1775 tons of hydrocarbons, 70 tons of aldehydes and ketones, 146 tons of other organic gases, 125 tons of aerosols, 695 tons of oxides of nitrogen, 585 tons of sulfur dioxide and 9,950 tons of carbon monoxide. It is valid to assume a uniform day-to-day gross potential, although adjustments might be considered for weekends, holidays, seasonal variations of activity, and yearly changes in the economy due to growth and control activity.

a. Maximum and Minimum Primary Potentials

The *primary pollution potentials* express relative source contributions to the major classifications of air contaminants and are computed at the current level of control technology. From these estimates the minimum and maximum emissions possible under ideal or adverse circumstances can be determined. A *maximum primary potential* may be defined, therefore, as that potential which results from the total engagement of the economy in its normal activities, without, or prior to, the assumption of control measures. A *minimum primary potential* is that potential resulting from the maximum control of the sources of air pollution through the application of the most advanced control techniques and devices available.

The maximum potential is an indication of the "absolute" potential of the economy to pollute the air. Since it is based on the conditions prevalent at the time a control agency begins operation, the maximum potential constitutes the sum of the actual, surveyed potential and the quantities prevented from entering the atmosphere as a result of an active control program. For Los Angeles, the maximum potential for 1960 exceeds 17,000 tons per day of all kinds of contaminants, and includes some 4,000 tons a day which have been controlled since 1948. This potential will continue to increase with the growth of population and economic activity.

The attainment of a minimum primary potential at any one time may not mean that air pollution is eliminated, but that emission rates are cut to irreducible minima. Further reductions must often await engineering solutions to uncontrolled problems. Moreover, some primary contaminants may be controlled to minimum levels, whereas others may continue at maximum levels until reduced. With the outstanding exception of hydrocarbons, carbon monoxide, and oxides of nitrogen, which are emitted primarily from uncontrolled automobiles, the rates of emission in Los Angeles County, as shown in Table I-13, approach the minimum pollution potentials. However, the minimum primary potential continues to grow with continued metropolitan growth.

b. Evaluation of the Primary Potentials

Although it is useful to rank the emissions of contaminants to the atmosphere in terms of weight-units, the primary potentials so computed have a limited meaning. Several considerations must be taken into account in evaluating the importance of these emissions. First, the dilution capacity of the atmosphere and the location and concentration of the sources of air pollution affect the concentrations the contaminants reach in the air. Secondly, each contaminant possesses unique chemical and physical properties which influence their capacity to enter into smog-forming reactions, their contribution to eye-irritation, their toxic potential, and their general reactivity in the atmosphere. The carbon monoxide potential of all sources (9950 tons per day) while significant, is of less consequence when the actual concentrations found in the air are below threshold levels, than the 695 tons

TABLE I - 13

SUMMARY OF AIR CONTAMINANT EMISSIONS IN LOS ANGELES COUNTY IN TONS PER DAY, 1960

(Prepared by the A.P.C.D. Engineering Division, January 1961)

EMISSION OF AIR CONTAMINANTS TO THE ATMOSPHERE, BY SOURCE, IN TONS PER DAY

SOURCE	ORGANIC GASES			AERO-SOLS	INORGANIC GASES			
	Hydro-carbons	Aldehydes & Ketones	Other Organics		Oxides of Nitrogen	Oxides of Sulfur	Carbon Monoxide	Other Inorganics
Transportation—Automobiles (b) - Exhaust	680	10	12	25	250	19	6850	n
- Blowby	140	u	u	u	u	n	n	n
- Evaporation (Gasoline)	145	0	0	0	0	0	0	0
(a) —Trucks & Buses - Exhaust	130	3	4	8	80	6	2100	n
- Blowby	40	u	u	u	u	n	n	n
- Evaporation	45	0	0	0	0	0	0	0
—Trucks & Buses (Diesel)	8	n	n	2	8	2	2	n
—Ships and Railroads	n	n	n	n	n	n	n	n
—Aircraft - Jet	n	n	n	1	1	0	1	0
- Piston	15	n	n	n	5	n	110	n
Petroleum —Refining	90	2	n	5	1	40	700	4
—Marketing	100	0	0	0	0	0	0	0
—Production	60	n	0	0	u	n	u	0
Organic Solvent Uses —Surface Coating	190	25	35	7	0	0	0	0
—Degreasing	20	n	40	0	0	0	0	0
—Dry Cleaning	20	n	8	n	0	0	0	0
—Plastics & Rubber	17	4	3	n	0	0	0	0
—Other	50	14	13	n	0	0	0	0
Combustion of Fuels (c) —Liquid	0	0	0	n	3	2	0	0
—Gaseous	5	1	3	11	184	8	1	0
(d) —Liquid	2	1	6	38	187	454	n	0
—Gaseous	4	1	2	14	150	13	1	0
Chemical —Sulfur Plants	0	0	0	0	n	30	0	0
—Sulfuric Acid Plants	0	0	0	n	n	20	0	0
—Other	16	8	16	8	n	1	0	1
Metals —	0	0	0	6	3	n	180	0
Incineration —Municipal	n	n	3	3	3	1	3	n
—Industrial	n	0	1	n	1	n	1	n
—Other	0	0	n	1	n	n	n	0
Minerals —	2	0	0	4	6	0	0	0
Miscellaneous —	u	0	u	2	0	u	0	u
TOTALS (Rounded) (d)	1775	70	145	125	695	585	9950	5

(a) These emissions are subject to confirmation by the current joint survey by L. A. County APCD, U. S. P. H. S., Calif. Health Dept., Auto. Mfrs. Assn., and Auto. Club of So. California.
(b) Includes trucks under 4000 pounds unladen weight
(c) Average emissions during effective period of Rule 62
(d) Average emissions during period Rule 62 not in effect

0 — 20.05 ton per day
n — negligible, (0.05 - 0.5 ton per day)
u — unknown

of oxides of nitrogen and the 1775 tons of hydrocarbons whose smog-forming tendencies are greater at relatively lower concentrations. The main value of the pollution survey arises from the comparison which can be made of the relative source contributions of a given contaminant, once the significance of the contaminants is established.

B. Secondary Pollution Potential

The *secondary pollution potential* may be defined as that capacity of the primary contaminants to interact in the atmosphere to produce new species and quantities of air contaminants. In assessing the secondary potential, two general categories of primary contaminants are considered, *reactants* and *non-*

reactants. Reactants are contaminants which are either so unstable as to be susceptible to chemical interaction with other contaminants present in the atmosphere, or which act as catalysts in promoting interaction among other contaminants. A non-reactant is a relatively stable contaminant which will not react or reacts too slowly to be of any consequence, and which retains its chemical identity. We shall include as non-reactants substances which merely alter their physical state due to changes in temperature, pressure and humidity, or the simple oxidation products of these contaminants. It is important to note that the reactivity of the contaminants is significant only if they contribute to the manifestations of the air pollution problem.

Current knowledge of the secondary reaction systems which take place in urban air is primarily an outgrowth of investigations into the causes and effects of Los Angeles smog. Prior to the Los Angeles problem, most air contaminants were viewed as non-reactants related directly to source effluents. The presence in the atmosphere of sulfur dioxide, sulfuric acid mists, carbon monoxide, carbon dioxide, carbon particles and fly ash — all relatively nonreactant as far as is known — were accounted for from the sulfur and carbon content of fuels. Early in the Los Angeles problem, however, certain gases and vapors — aldehydes, organic acids, organic peroxides, and ozone — were found in the atmosphere in concentrations that could not be accounted for from the known sources of air pollution. Although large quantities of hydrocarbons were known to be emitted into the atmosphere, their consequence was dismissed since it was believed that hydrocarbons broke down into carbon dioxide and water, relatively harmless substances. The contaminants in the air responsible for eye-irritation, plant damage and reduction in visibility, moreover, were not related to any contaminants known to be in the air. Although sulfur dioxide was suspected, since low concentrations were known to cause plant damage and eye-irritation; the concentrations measured in the air were insufficient to indict this contaminant. Moreover, eye-irritating substances like acrolein and formaldehyde also were not found in sufficient quantities to account for all of the eye-irritation. It became increasingly apparent that atmospheric reactions were taking place which could not be explained in terms of the traditional air pollution problem.

Dr. A. J. Haagen-Smit, Professor of Chemistry at the California Institute of Technology, and a consultant to the Los Angeles County Air Pollution Control District, first identified in 1953 the rather singular mechanism by which smog is produced in Los Angeles County. He discovered that the irradiation of mixtures of nitrogen dioxide and organic gases, primarily olefinic hydrocarbons, with the ultra-violet portion of the spectrum produced both ozone and the type of plant damage found in the area. Thus, two of the effects of smog, ozone and plant damage, were related to a photochemical mechanism presumed to embrace a variety of chemical reactions and end effects peculiar to Los Angeles smog(10). "Photochemical smog," as Los Angeles pollution came to be known, opened up an entirely new field for investigation.

Subsequent tests by Haagen-Smit and others not only confirmed this relationship, but synthetic smogs were created in the laboratory from the reactions of oxides of nitrogen and hydrocarbons in the presence of sunlight which reproduced all of the known effects of Los Angeles smog, including visibility reduction and eye-irritation(11). These reactions required only the presence of the two primary reactants, oxides of nitrogens and hydrocarbons, and ultra-violet light under normal atmospheric conditions. The inter-relationship was further established by the fact that the absence of any one of these variables was sufficient to prevent the reaction.

Although this theory identified the basic reactants in Los Angeles smog, the contaminants causing eye-irritation and plant damage and the precise chemical reactions which take place, are still unexplained. Certain relationships between reactants and end effects, however, are sufficiently known to permit intelligent research into a further understanding of the reactions. In general, a series of chemical reactions take place involving (1) primary reactions between organic materials (hydrocarbons) and atoms of oxygen released from the photochemical dissociation of nitrogen dioxide, (2) newly formed compounds such as ozone and organic materials, and dissociated components of molecular compounds such as free radicals and free atoms — substances which are not only available for further reaction, but which probably produce the typical smog effects, and (3) secondary reactions which produce end-products such as alkyl-nitrates, carbon dioxide, formaldehyde, formic acid and materials which probably contribute to the oxidizing capacity of the atmosphere(8).

1. Primary Reactants in Los Angeles Smog

In Los Angeles County, the two principal contaminant reactants participating in the photochemical smog reaction are certain classes of hydrocarbons (1180 tons from vehicle exhaust, 300 tons from organic solvent uses, and 250 from petroleum refining and production) and 695 tons of oxides of nitrogen. Both contaminants are emitted in the form of a gas or vapor.

a. Hydrocarbons

Hydrocarbons are a class of organic materials comprising thousands of compounds made up of hydrogen and carbon classified by carbon-hydrogen ratio, and by structure as paraffins, naphthenes, aromatics and olefins. The speed at which the photochemical reaction occurs, the products formed and the effects produced are closely related to the composition and the structure of the hydrocarbon classification. Some hydrocarbons are highly stable, and may be classed as non-reactants, whereas others possess relatively unstable structures which react under appropriate influences.

The structures of hydrocarbons, with respect to their reactivity, are divided between saturated and unsaturated hydrocarbons. *Saturated* hydrocarbons, such as the paraffiins and naphthenes, are made up of satisfied valency bonds, i.e., the hydrogen and carbon atoms are appropriately matched. *Unsaturated* hydrocarbons, such as the olefins, diolefins, and acetylenes, which are straight or branched-chain hydrocarbons containing one or more double bonds, possess a deficiency in hydrogen which is readily satisfied by reaction with other compounds.

The smog-forming potential is also dependent on the properties of the specific hydrocarbons, particularly on their ability to be oxidized. Generally speaking, hydrocarbons possessing more than four, but less than nine carbon atoms, enter into the smog reaction. Of these, the olefins are considered to be the most important. Other hydrocarbons, such as some branched-chain paraffins and many forms of aromatics, as well as certain hydrocarbon derivatives resulting from intermediate reactions are reactive in varying degrees, and may all be proportionately involved in the smog reaction, especially during prolonged smog sieges(8).

By far the largest source of olefins is the unburned gasoline emitted from exhaust pipes and carburetors of motor vehicles. Some seven per cent of all gasoline used in the automobile is estimated to be exhausted to the atmosphere in an unburned state. The hydrocarbons and oxides of nitrogen are mixed in the exhaust, and when this mixture is exposed to sunlight, the rapid smog reaction takes place.

Hydrocarbons are also emitted in substantial quantities into the atmosphere from the evaporation of petroleum products and organic solvents. The rate at which such products evaporate, or vaporize, is directly related to their vapor pressure. Products with high vapor pressure generally consist of cracked petroleum stocks and distillates such as gasoline, aviation gasoline, propane or butane, liquid petroleum gas, some jet fuels, and some solvents and naphthas.

b. Oxides of Nitrogen

Oxides of nitrogen — principally nitric oxide and nitrogen dioxide — are inorganic gases formed by the fixation of elemental oxygen and nitrogen at high temperatures, such as occur during combustion. Nitric oxide, which is first formed in the exhaust, oxidizes to nitrogen dioxide. Nitrogen dioxide, in turn, dissociates from the absorption of sunlight causing oxygen to be released. Some of the oxygen atoms react with oxygen molecules (O_2) to form ozone (O_3), while others react with organic materials and water vapor to produce a series of complex reactions which generate free radicals and other intermediate reaction products(14). The oxides of nitrogen thus can be said to provide the oxygen atoms necessary for the photochemical oxidation of organic materials.

2. Total Oxidant and Ozone

Aside from ozone, which is clearly the cause of rubber cracking, each of the effects of air pollution — eye-irritation, visibility reduction and plant damage— is presumed to be caused by a different, and as yet unidentified, reaction product. It is thus not yet possible to quantify and classify the secondary pollution potential — the secondary and intermediate reaction products — in the manner of the primary pollution potential. However, a readily measurable indication of the over-all reactivity of smog is the oxidizing capacity of the contaminated atmosphere. This index of smog reactivity is known as *total oxidant*.

Total oxidant may be defined as all those substances in the air — ozone, some peroxidic compounds, immeasurably small quantities of oxygen atoms and other substances — which make available oxygen or oxygenated compounds for chemical reaction. Practically all of the oxidants are attributed to intermediate and secondary reactions rather than to primary source origin.

In actual chemical measurement, total oxidant is the measure of an amount of iodine released by the exposure of a stream of contaminated air to a buffered neutral potassium iodide reagent. This is a specific chemical method amenable to automatic sampling, and is not necessarily an absolute measure of all of the oxidants. Consistent use of this method, however, provides a reliable tool for comparing the reactivity of an atmosphere from time to time, and is used by control agencies as a check on the measurement of other contaminants in the air. An atmosphere with a high oxidant potential is a fairly good over-all indication of a high secondary potential, although no precise correlation can be made with any of the other contaminants found in the atmosphere.

In addition to its contribution to the smog reaction, ozone (the major oxidant) is an important contaminant which will not only crack rubber, but will affect human health at concentrations as low as 1.5 parts per million. Concentrations of ozone can be specifically measured by a rubber-cracking method, and by the ozone photometer.

C. *Contaminant Levels*

The concentrations contaminants reach in the atmosphere is a function of the rate at which they are emitted from the pollution zone and the period of time the polluted air remains in the zone. In Los Angeles, contaminants build up and are retained long enough to permit them to undergo photochemical reaction, usually during a period which lasts from four to six hours each day. During that time the air contains continuous quantities of "fresh" primary contaminants, intermediate reactants and end products or "aged" pollution. We may refer to the measured volumetric concentrations (in parts per million of air) of the principal contaminants in a representative parcel of air at any point of the smog attack as the *contaminant level*. During this period, the level of the important contaminants and reactants will increase, but not at the same rate. Some will reach and then maintain a steady level, whereas others will increase rapidly and then drop off sharply as atmospheric conditions change.

TABLE I - 14

TYPICAL RANGES OF AIR CONTAMINANT LEVELS ON SMOGGY AND NON-SMOGGY DAYS

CONTAMINANT	RANGE PARTS PER MILLION TYPICAL CONTAMINANT (v/v)		RECORD MAXIMUM VALUE PARTS PER MILLION (v/v)
	SMOGGY DAY(a)	NON-SMOGGY DAY(b)	
Aldehydes	0.05-0.60	0.05-0.60	1.87
Carbon Monoxide	8 -60	5 -50	72.0
Hydrocarbons	0.20-2.00	0.10-2.00	4.66
Oxides of Nitrogen	0.25-2.00	0.05-1.30	2.65
Oxidant	0.20-0.65	0.10-0.35	0.75
Ozone	0.20-0.65	0.05-0.30	0.90
Sulfur Dioxide	0.15-0.70	0.15-0.70	2.49
Km(c)	5.0-15.0	4.0-14.0	24.8

(a) Defined as a day with severe eye-irritation in Central Los Angeles.

(b) Defined as a day with no eye-irritation in Central Los Angeles.

(c) Arbitrary units providing a measure of dark-colored air-borne particles.

Source: *Reference* 28.

The control agency is concerned with the levels of pollution for several reasons. First, it must monitor the concentrations of the principal contaminants in order to detect an approaching health menace or disaster. Second, it must determine contaminant trends to either detect gradually worsening conditions, or to verify the effect of the reduction of primary potentials by control measures. Third, it must know how contaminant levels correlate so as to learn more about reactant relationships, and to provide bases for accurate smog forecasts. And finally, it will need to develop substantial and accurate data from which standards of air quality can be formulated for the purpose of safeguarding the long term health of the population.

1. Monitoring the Key Contaminants

Air monitoring can be considered in two phases: (1) continuous monitoring of the pollution levels with sampling equipment located at strategic positions in the pollution zone, and (2) monitoring of the effects of contaminants such as plant damage and eye-irritation.

KEY CONTAMINANTS MONITORED IN LOS ANGELES COUNTY (12)	KEY EFFECTS MONITORED IN LOS ANGELES COUNTY
Carbon Monoxide	Eye-Irritant
Oxides of Nitrogen	Plant Toxicant
Ozone	
Oxides of Sulfur	
Particulates (Km)	
Total Oxidant	

It is impractical, of course, to conduct continuous automatic monitoring of *all* contaminants which may be found in the air due to the limitations and expense encountered in current instrumentation techniques. The control agency must therefore adapt its monitoring program towards the key contaminants.

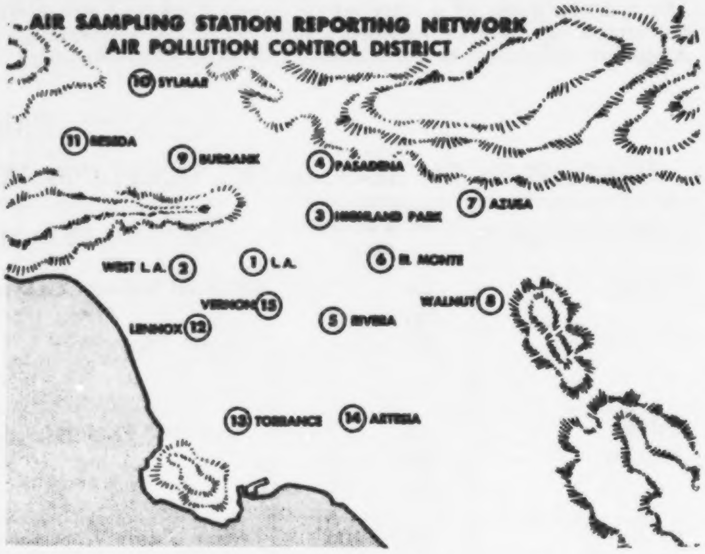

Figure I - 10. Typical distribution of air-sampling stations in Los Angeles County.

In Los Angeles County, the monitoring of ozone, sulfur dioxide, oxides of nitrogen and oxides of sulfur on a 24-hour basis at six stations is required by Regulation VII of the District Rules and Regulations. The specific purpose of monitoring stations is to determine when these contaminants approach and exceed the concentrations set forth in the various alert stages as defined in Rule 156.

TABLE I - 15

ALERT STAGES FOR TOXIC AIR CONTAMINANTS (PPM)

REGULATION VII CONTAMINANTS	ALERT STAGES			NUMBER OF ALERTS CALLED IN LOS ANGELES COUNTY			
	First Alert	*Second Alert*	*Third Alert*	*Year*	*First Alert*	*Second Alert*	*Third Alert*
Carbon Monoxide	100	200	300	1955	15	0	0
Nitrogen Oxides	3	5	10	1956	10	0	0
Sulfur Oxides	3	5	10	1957	1	0	0
Ozone	0.5	1.0	1.5	1958	8	0	0
				1959	4	0	0
				1960	2	0	0

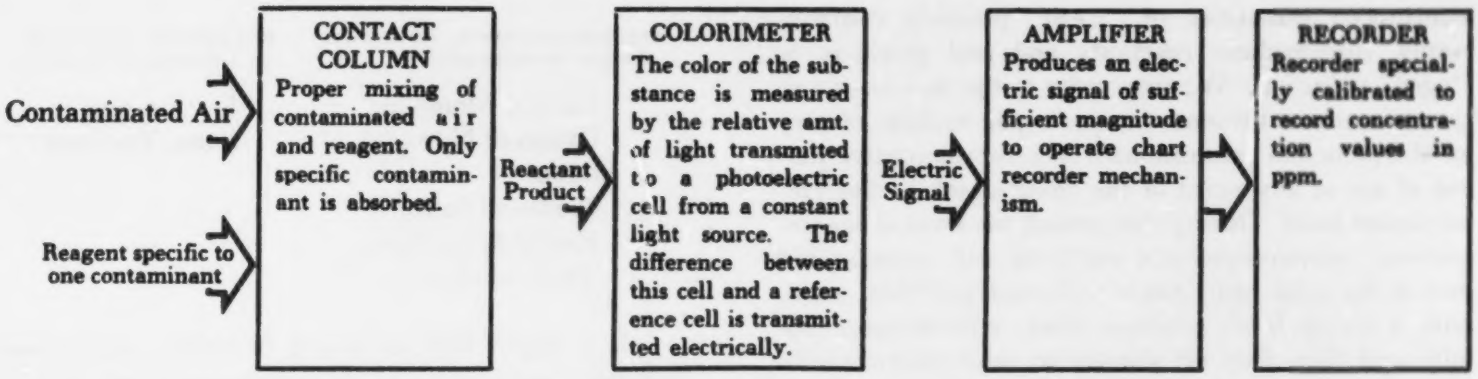
CONTACT COLUMN
Proper mixing of contaminated air and reagent. Only specific contaminant is absorbed.
Contaminated Air
Reagent specific to one contaminant
Reactant Product
COLORIMETER
The color of the substance is measured by the relative amt. of light transmitted to a photoelectric cell from a constant light source. The difference between this cell and a reference cell is transmitted electrically.
Electric Signal
AMPLIFIER
Produces an electric signal of sufficient magnitude to operate chart recorder mechanism.
RECORDER
Recorder specially calibrated to record concentration values in ppm.

Figure I-11. SIMPLIFIED DIAGRAM OF A TYPICAL AUTOMATIC AIR SAMPLING DEVICE. Under Regulation VII, the Los Angeles APCD continuously monitors the atmosphere for certain contaminants at 6 air-monitoring stations. The monitoring instruments at these stations utilize a chemical or physical property of a specific contaminant in their design. By proper selection of equipment and electronic circuitry each instrument provides a continuous chart showing a specific contaminant level. Although there are significant variations, these instruments are generally designed to accomplish the following processes: metered amounts of contaminated air are drawn through the instrument to a Contact Column which then mixes the contaminated air with an appropriate absorbing agent. The reaction gives off a color which is measured photometrically in a Colorimeter according to the differences in light absorption from a common light source, between a sample cell and a reference cell. An electrical signal is then transmitted from the Colorimeter to an Amplifier and thence to a specifically calibrated Chart Recorder.

TABLE I-16

PRINCIPLES OF AUTOMATIC SAMPLING DEVICES EMPLOYED IN LOS ANGELES COUNTY

CONTAMINANTS	ALERT LEVELS (ppm)	SAMPLING DEVICE	BASIC CHEMICAL PRINCIPLES
Ozone	1st .5 2nd 1.0 3rd 1.5	(Manual Rubber Cracking) • • • • Ozone Photometer	(Concentration of ozone is computed at rate at which rubber cracks) • • • • • Absorption of ultra-violet light of a certain wave length by ozone. Ozone-free reference cell, reduced by MnO_2 catalyst, compared with the ozone in the contaminated air in sample cell.
Sulfur Dioxide	1st 3 2nd 5 3rd 10	Thomas Autometer	Absorption of SO_2 by distilled water solution in hydrogen peroxide and in sulfuric acid with simultaneous oxidation to sulfuric acid. Measurement is made of the electrolytic conductivity of the solution rather than color-change.
Carbon Monoxide	1st 100 2nd 200 3rd 300	Mine Safety Appliance Lira-Gas Analyzer	Employs principle of non-dispersion, infra-red spectroscopy. Measures the relative differences in the expansion of a known concentration of CO alternately from the unabsorbed infra-red radiation passing through a pure nitrogen cell and a cell containing the air to be sampled.
Oxides of Nitrogen	1st 3 2nd 5 3rd 10	Borman Engr. Inc.	Both NO and NO_2 are measured consecutively. NO_2 is measured by change of color resulting from the reaction between NO_2 and the absorption solution (Saltzman Reagent). The sample is then passed through a potassium permanganate solution to oxidize the NO to NO_2, and then treated again with Saltzman. The product of the reaction in each instance passes through a photoelectric cell — one for NO and the other for NO_2.
Total Oxidant	To check ozone and sampling data	Beckman Oxidant Recorder	Reaction of oxidants in an air stream with a buffered neutral 20 per cent potassium iodide reagent. Measurement is made of the iodine release by a recording double beam colorimeter.
Km	To measure the general dirtiness of air	Chaney Auto Sampler	Blackness of filter spot is measured by means of light reflectance or transmittance.

While the first alert is primarily a warning alert, the second and definitely the third alert may call for emergency action as outlined in the Regulation (see Chapter 3). The alert stages also provide a reference for comparing the relative intensities of the pollution levels. In addition to meeting Regulation VII requirements, the Air Pollution Control District also monitors or samples nitric oxide, total oxidants, ether-soluble aerosols and particulate matter to provide more complete data on contaminant levels.

2. Monitoring Key Effects

Plant toxicants (phytotoxicants) are measured by estimation of total leaf damage resulting from daily exposure of smog to fresh, carefully grown plants in test boxes. For such measurements, *poa annua* and petunia are used. Eye-irritation is measured in terms of a questionnaire graded on an hourly basis and is compared to monitored concentrations and weather conditions.

Figure I - 12. Automatic sampling device for atmospheric particulates.

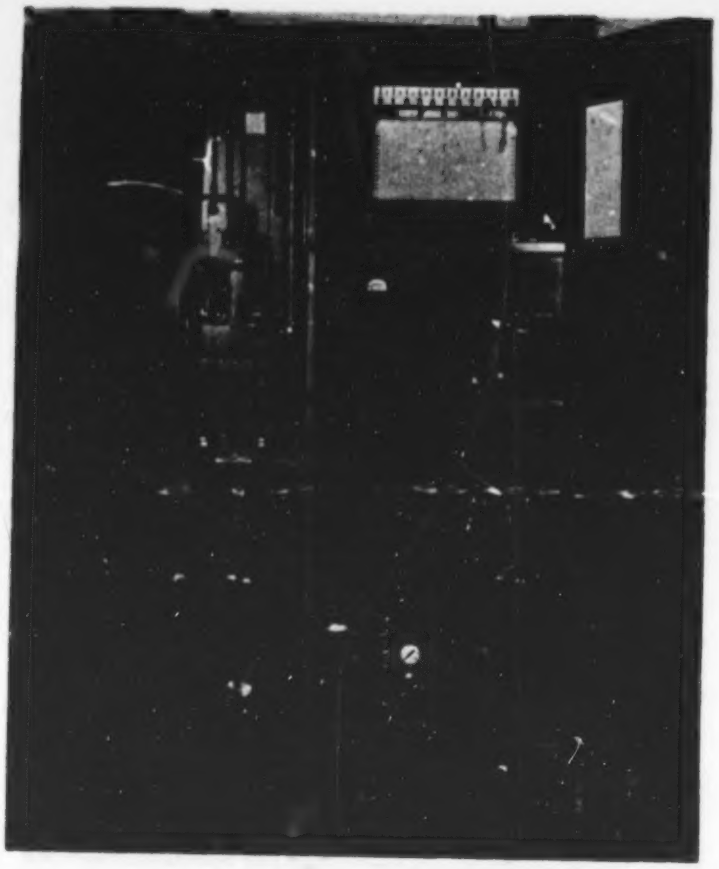

Figure I - 13. Automatic sampling device for nitric oxide and nitrogen dioxide.

Figure I - 14. Luft Principle gas analyzer for carbon monoxide with automatic recorder.

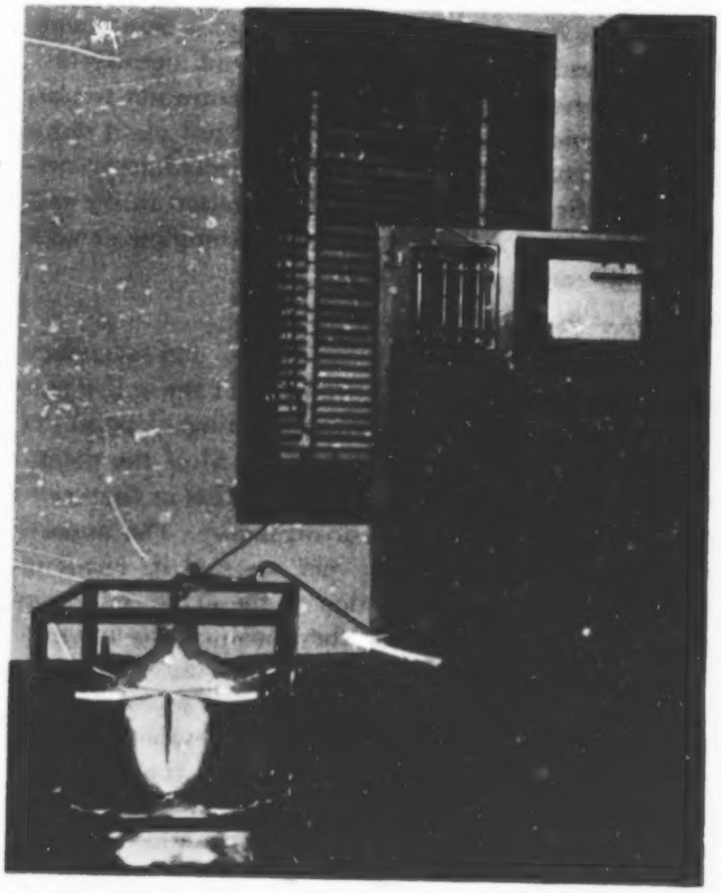

Figure I - 15. Automatic sampling device for both oxidant and oxidant precursor.

Figure I - 16. Thomas autometer used for measuring sulfur dioxide in the atmosphere.

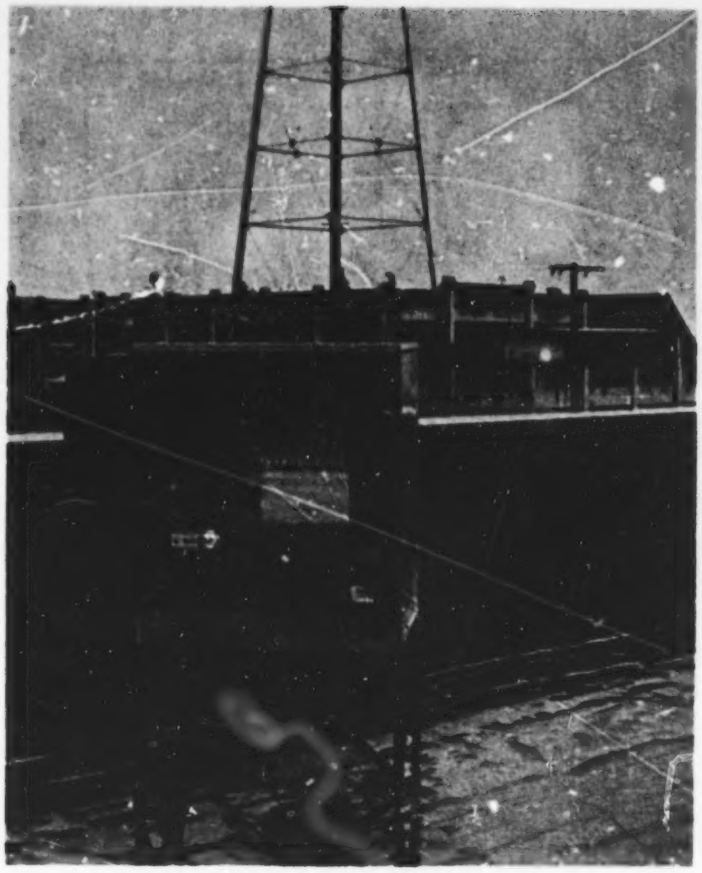

Figure I - 17. Spectroradiometer receiver unit for long path ozone recorder. The light source may be seen in the background to the right of the receiver.

In Los Angeles County, an attempt is being made to refine and correlate this data so as to identify any possible correspondence between concentration trends, weather conditions and eye-irritation and plant damage. Unfortunately, the Los Angeles monitoring network, the first of its kind, began operation in the last three years and not all of the data is complete enough to permit consummate analysis.

D. Other Pollution Potentials

We have considered both primary and secondary pollution potentials as they prevail over the entire pollution zone. To complete an accounting of pollution potentials, it is necessary to include all of the potentials of individual sources of air pollution as they contribute to unique problems or nuisances. The importance of these problems is not assessed in terms of their quantitative contribution to the entire pollution potential, but by the effect they have on the inhabitants of a community neighboring the source in terms of smoke, odors, soot, dust and corrosive deposits. Both primary contaminants and reactants may be involved, particularly where odors and corrosive contaminants are concerned. The degree of reactivity of such contaminants is often quite out of proportion to the quantities emitted.

Pollution potentials of this type are related to the legal problem of public nuisances resulting from high

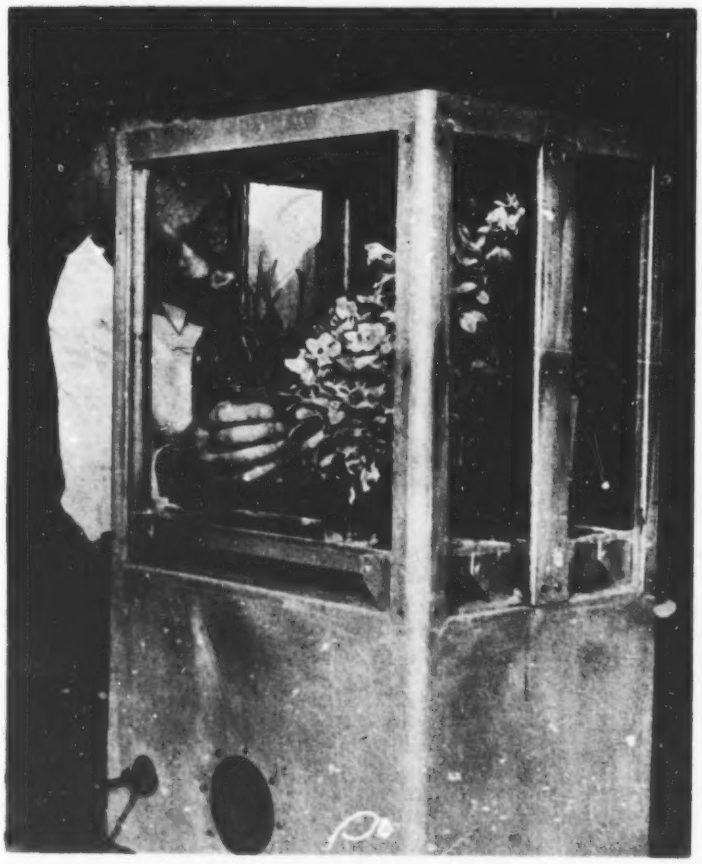

Figure I - 18. *Poa Annua* (annual blue-grass) and Petunia are placed in fumigation and filtered air chambers to assess the damage to these plants from exposures to smog.

population densities and the crowding of commercial, residential and industrial areas. Industries which emit nuisance contaminants like odors (such as the animal rendering industries and other "obnoxious" trades), toxic materials or corrosive acids (such as refineries and chemical plants), dusts (such as cement manufacturers and mineral processors) and fumes and smoke (such as foundries and steel mills) must be given special attention even though they may not contribute significantly to the total air pollution potential.

E. Pollution Potentials Determine Control and Enforcement Objectives

As we have seen, the causes of air pollution are divided between those which are natural in origin, such as climate, topography and weather, and those which are man-made, such as the growth of the metropolitan economy and its pollution potentials. Since the weather cannot be controlled, the control of air pollution must be accomplished by reducing the primary and secondary pollution potentials, either by applying control techniques and devices to reduce emission rates, by abolishing sources of air pollution, or by distributing the sources of air pollution through zoning ordinances to dilute contaminant plumes. The minimum and maximum primary potentials significant to the saturation of the local air space thus establish realistic objectives for control. Control activities then fall into two complementary phases: research and control operations.

1. Research

The research activity is concerned with ascertaining pollution potentials and levels and their effects on the environment, as well as the devices and techniques which will accomplish control. Research findings inform legislative bodies of the standards required for control regulation. The control agency then attempts to realize minimum primary potentials.

2. Control Operations

The control operations are primarily concerned with the enforcement of legal standards to achieve the maximum practicable reduction of the pollution potentials. At the same time, the control agency must monitor the atmosphere and forecast pollution conditions in order that action can be taken to avoid disasters.

Field operations is essentially a law-enforcing function involving the inspection and registration of the sources of air pollution, continuous surveillance of the pollution zone, investigation of specific air pollution problems, promotion of zone wide compliance, and prosecution of air pollution violators, continuously and simultaneously in all parts of the pollution zone.

The attainment of the minimum pollution potential is thus a basic operational function of the enforcement program.

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CHAPTER TWO

THE TECHNOLOGY OF SOURCE CONTROL

I CONTROL TECHNIQUES

Just as the metropolitan area possesses a potential to pollute the air, so does it possess a definite potential to prevent that air pollution. The control of air pollution is *preventive* in nature since the atmosphere can't be cleaned artificially once it has become polluted. Cleaning the atmosphere by such methods as "inversion breaking," "air blowers," "air filtering," or "rainmaking" is tantamount to revolutionary weather modification, not feasible at the present time.

The capacity of a community to prevent air pollution is limited to reducing pollution potentials through one of more of the following methods:

A. Eliminating the sources of air pollution.
B. Controlling source area pollution through zoning.
C. Controlling or changing the sources of air pollution.

A. Eliminating the Sources of Air Pollution

The elimination of the sources of air pollution is motivated by the assumption that nothing short of absolute control can be tolerated. Advocates of this approach claim that reduction of air pollution at the source is only a relative matter; real control is not achieved unless the actual source is entirely prohibited or eliminated. This concept would, in the extreme, assign to the state powers which could be used to confiscate the sources of pollution or to prohibit their use.

Although this approach represents an extreme, especially when applied to all of the sources of air pollution simultaneously, there are instances in which it is reasonably applied. These depend on the need for absolute control of a given source of air pollution, and constitutional powers and limitations. Sources of air pollution which are completely unessential to the economy, such as single-chamber incinerators, open fires, and dump burning, may be completely banned when substitute practices become available. Certain types of fuels — such as soft coal or fuel containing excessive quantities of sulfur and impurities, may be banned altogether when cleaner fuels become available. Industries which are anomalous to the character of the community can be outlawed through zoning ordinance restrictions or by direct prohibition. The elimination of a widespread existing practice, however, depends on the availability of materials or processes which can be reasonably and economically substituted.

B. Controlling Area Source Pollution Through Zoning

Control of air pollution is based on treating the entire pollution zone, or area subdivisions within that zone, as sources of air pollution which can be regulated to maximize the prevailing dilution capacity of the areas. Essentially, this consists of regulating source density, the space intervals between sources and potential effect areas, the time periods contaminants are released, and raw materials and processes employed. The prime objective of such zoning is to place source and effect areas in such relationship to one another, and of such density, as to allow for sufficient dilution of contaminated air. This may be accomplished by confining industries with high pollution potentials in "wind corridors" where, as a result of terrain, streamline patterns, and turbulence, etc., contaminants are readily dispersed. By placing industry in the downwind peripheries of the pollution zone, areas of high population density and chronic atmospheric stagnation can be avoided.

Another zoning technique is to establish "smokeless zones" either through creation of agricultural or "buffer" zones between industrial and residential areas, or by applying stringent regulation of equipment and fuels in areas of high source concentration. "Smokeless zones" were first applied in England in such industrial towns as Coventry, Manchester, and Bolton, where they range in area from 30 to more than 100 acres. In these zones the emissions of the visible and particulate products of combustion are prohibited, heating equipment is revamped, and bituminous coal is replaced by electricity, gas, or coke.(7)

The zoning of source areas to minimize the effects of air pollution, especially in large diversified economies, is complicated by growth patterns, economic and legal factors, and by the need for detailed information necessary to forecast future growth patterns and to determine the dilution capacities of the respective source areas. Research is required in the following areas: (6)

1. The pattern of natural dilution capacity.
2. The determination of community air standards.
3. Forecasts of locations of future source emissions.
4. The classification of industries by their pollution potentials.
5. Air monitoring network coverage.

Zoning through legal sanctions is within the concept of the police power of the state, when sufficient evidence established through objective zoning studies can be presented. Air pollution zoning can be legally applied to prohibit new industries, limit expansion of existing industries, liquidate non-conforming industries after amortizing their existing investments, or eliminating existing harmful industries.(6)

Air pollution zoning, however, is somewhat circumscribed by the number of variables and costs involved. Radical modification of the existing growth

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pattern through forced relocation of industries is probably impossible, if not undesirable. Air pollution zoning plans, therefore, must be applied through coordination of existing metropolitan zoning functions, urban redevelopment programs, or to normal growth patterns through continuous surveillance of land use and past and future emission factors. To some degree, local zoning ordinances take into account air pollution factors along with noise, glare, vibration, fire hazards, water pollution, traffic, aesthetics, and psychological effects.(14) These ordinances are enforced to segregate commercial, industrial, and residential activities, although not always in a manner that would prevent air pollution problems. Planning agencies should thus be supplied with sufficient information on specific air pollution problems as will provide a sound basis for rendering expert zoning decisions. As new industries are established, and older industries change ownership or seek to relocate themselves voluntarily, they become subject to new zoning laws. Similarly, residential communities can be prevented from entering industrial areas.

C. Controlling the Sources of Air Pollution

Most air pollution control activity to date has been directed at effecting changes in equipment or operations to prevent the emission of air contaminants. These are control techniques and devices applied at any appropriate point in the process or operation cycle of equipment — from the charge of the feed (fuel, material, and air) to the equipment, the flow of such materials through the equipment, to the discharge of contaminated air and other waste products accumulating at the completion of the operation cycle. Control may be effected through any one or combination of the following methods:

(1) instituting operational and maintenance techniques to rigidly control the handling of fuels, materials, and equipment so as to minimize contaminant losses;

(2) incorporating design features in equipment to efficiently utilize all materials and fuels to prevent contaminant losses;

(3) replacing or altering the composition of fuels or materials, so as to reduce or eliminate those volatile or impure elements which cannot be utilized or collected by the equipment; or

(4) installing control or collection devices which will either eliminate the contaminant through combustion, chemical reaction, or collect the contaminant by entrapment.

A well developed control technology now exists which makes available a variety of techniques and devices to virtually the whole range of industrial practices in the metropolitan economy. A considerable economic choice in the selection of suitable control methods is available to plant operators. In each instance, the operator can select that control technique which will attain the required collection or control efficiencies, and minimize cost from the standpoint of the initial investment and long term maintenance and operation.

While most air pollution problems can be controlled through available techniques, many air pollution problems require engineering development for their solution. These include problems arising from the collection or control of dilute concentrations of contaminant gases, such as the organic vapors, particles which are much smaller than 1 micron, certain contaminant gases such as oxides of nitrogen, oxides of sulfur, carbon monoxide, and various unique operational problems encountered at power plants, steel manufacturing, animal rendering industries, and solvent handling. Furthermore, as populations continue to grow, refinements of existing control techniques are required.

1. Operational and Maintenance Techniques

Control through operation and maintenance concerns the skill and care taken to operate equipment and maintain equipment in good working order, and in the handling of fuels and materials fed to the equipment. These practices are frequently mandatory not only to efficiently fulfill the function of the operation, but to prevent air pollution. For most air contaminating equipment, optimum operational efficiency means maximum control of air pollution, whereas air pollution usually results whenever production practices exceed design standards of equipment. Combustion equipment, for example, can only be efficiently operated within design-specified air-fuel ratios, fuels, ignition and combustion temperatures, and at rated capacities. Similarly, in metal melting, good operational technique means controlling temperatures to prevent excessive volatilization and fuming. Operational techniques employed to purify metals (degassing and slagging, use of ingot rather than scrap, etc.) also contribute to product excellence, as well as to the reduction of air pollution.

This manual, of course, cannot attempt to even sample the operating practices applied at all of the sources of air pollution. These are as numerous and diverse as the technology itself, and will engage the complete technical skill of the control operation. We shall deal with these as they become involved in specific air pollution problems later in this manual. It is sufficient here to point out various functional difficulties which contribute to poor operating efficiency, assuming that equipment possesses an inherent capability for control. These are:

a. *Sacrifice of Operational Efficiency for Volume Production.* Disproportionate increases in contaminant emissions frequently result from overloading equipment to meet production demands beyond the capability of equipment.

b. *Use of Unusual Fuels or Process Materials.* Fuels and materials with unusually high amounts of impurities or volatile elements not specified for use in the equipment, or feeds which are inadequately prepared or conditioned before introduction to the process, may emit contaminants in excess of those correctly used.

c. *Inexpert or Insufficient Supervision of Equipment.* Poor operational technique may result from a lack of knowledgge, skill, or training. Batch processes (starting and stopping), in particular, are usually more difficult to control. Most contaminants in batch processes are emitted at the beginning and the completion of the cycle where peak operation efficiency either is not yet attained or drops off. Continuous processes, while less variable, must be checked for proper functioning.

Ignorance or negligence on the part of operators often results when management itself is disinterested in the pollution potentials of the plant, particularly where the loss of air contaminants is not critical to the economics of the plant. Insufficient supervision, also, as a result of personnel shortages, affects the operational efficiency of the plant.

d. *Inadequate Maintenance.* Lack of care in maintaining equipment in peak operating condition may cause equipment malfunctioning and failure, thereby creating air pollution. Equipment should be checked, repaired, and maintained so as to permit operation within design standards. Particular attention should be paid to hood and duct fittings, leaks or corrosion in ductwork, impaired passages in combustion equipment, faulty regulation of automatic feeding equipment, damaged or encrusted burner tips, grates, etc.

e. *Time and Temperature.* When time and temperature variables are subject to manual control, they are frequently very critical in the generation of air contaminants. This is particularly true of such equipment as boilers, furnaces, and metal melting where smoke and fumes readily result from irregularities in temperature and time interval of the heat or melting cycle.

The operation of equipment is frequently aided by instruments which monitor air pollution along with operational efficiency and product quality. Draft and flow pressure gauges, photoelectric smoke detection equipment, stack analysis, recorders, mirrors in stacks, explosimeters, pyrometers, and thermometers, etc., are invaluable aids to trained operators.

Suitable operational and maintenance practices are of importance regardless of whether or not the equipment incorporates control design characteristics or control devices are used, since neglect of these factors directly affects the pollution potential of the source. If control equipment breaks down or collection efficiency reduces as a result of poor maintenance, the source may emit pollutants at or near its maximum potential.

Operational and maintenance practices are of utmost importance when they are employed as the sole control technique. In many instances, basic equipment is designed with a capability of complete control which can be realized only by the skill of a trained operator. In other cases, the poor control features of old, inefficient equipment can be successfully compensated for by alert operational and maintenance practices.

Because of the variability of the human factor, general control efficiency is not attained by reliance on operation and maintenance only. Far greater reliance must be placed on design standards and equipment of high collection or control efficiency which possess a capacity to operate in an automatic, trouble-free manner and with minimum maintenance. It is thus desirable to reduce, though it can never be fully eliminated, the variability of the operational and maintenance factor.

2. Control Through Design of Basic Equipment

By far the most important technique of controlling air pollution is in the design of basic production equipment to efficiently utilize or completely consume materials. Generally speaking, the greater the design efficiency, the less air pollution. Because economy, good design, and minimum material losses go together, a greater control effort is made in ever improving the design of production equipment.

Considerable progress has been made, particularly in such categories of combustion equipment as boilers, furnaces, heaters, ovens, and incinerators. Design improvements have not only made possible the smokeless combustion of fuels, but increases in the output of thermal energy and the conservation of fuels. Essentially, this equipment is designed to provide sufficient temperature to permit complete combustion throughout ignition, burning, and burn-down, sufficient mixing or turbulence of air with combustion materials and fuels, and sufficient time interval to allow complete combustion, hence complete disposal of all of the components of the fuel or materials, including dilute volatilized gases and fly ash. Strict attention is paid to the dimensions and design of combustion chambers, burners, grates, and control of air supply (Figure II - 1). Burner designs for oil burning boilers and power plants are designed to preheat liquid fuels to reduce viscosity of the fuel, and to atomize the fuel with air or steam so as to efficiently provide proper air-fuel mixtures. Cross-fed, chain-grate stokers have been developed for burning volatile solid fuels such as bituminous coal. "Smoke eliminator" doors, and other accessories have been designed to provide sufficient secondary air to eliminate smoke during the ignition of coal. Multiple-chamber incinerators, consisting of two or more combustion chambers, have been developed for the smokeless combustion of a wide range of indus-

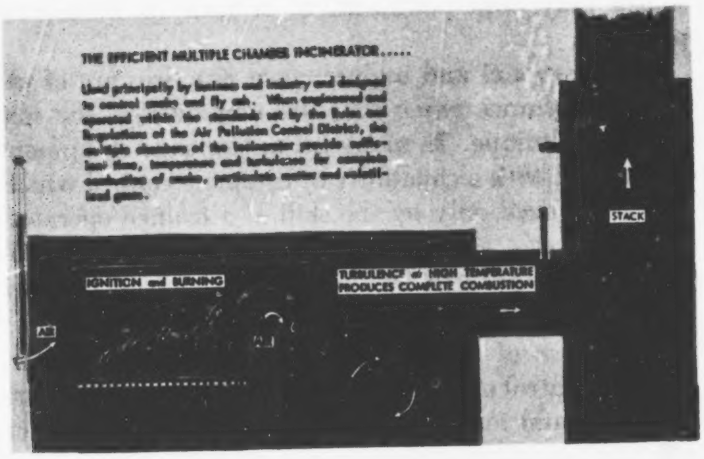
THE EFFICIENT MULTIPLE CHAMBER INCINERATOR.....
Used principally by business and industry and designed to control smoke and fly ash. When engineered and operated within the standards set by the Rules and Regulations of the Air Pollution Control District, the multiple chambers of the incinerator provide sufficient time, temperature and turbulence for complete combustion of smoke, particulate matter and volatilized gases.
STACK
IGNITION and BURNING
TURBULENCE at HIGH TEMPERATURE PRODUCES COMPLETE COMBUSTION
AIR

Figure II - 1. Combustion sequence through an in-line multiple chamber incinerator.

trial, commercial, and domestic types of rubbish. Furthermore, automatic and continuous feeding equipment is designed so as to accommodate proper air-fuel ratios for variable load conditions, thus reducing the effects of human error resulting from manual operation and maintenance.

In the metallurgical field, furnaces have been designed to operate without control equipment under many operating conditions. When ingot or pig iron is melted in the electric steel furnace, or refined metal is melted in most crucible or other metallurgical furnaces, a relatively fume-free operation results. A reverberatory type of furnace has been designed for nonferrous metals which attains a luminous heat from the reflection of light from the arches in the roof and sidewalls of the furnace. Since melting temperatures are reached quickly in this type of furnace, it can be used to melt various alloys with relatively less fuming than most conventional furnaces.

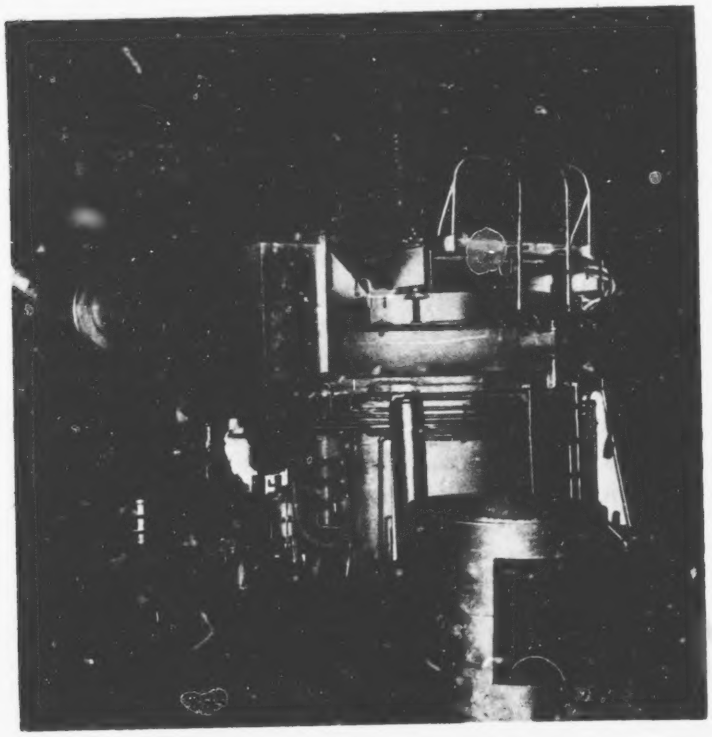

Figure II - 2. Electric-steel furnace.

Design improvement may not only be applied to individual pieces of equipment, but to the entire process flow of an industrial plant to minimize pollution potentials from equipment, material handling, and plant housekeeping activities. The flow of materials may involve mechanical and thermal processes, such as batching, blending, grading, roasting, drying (connected by sealed conveyor systems), or chemical processes, particularly in chemical and petrochemical plants and petroleum refineries, where product molecules are separated, converted, or otherwise altered by means of chemical, catalytic, or thermal processes. An entire process, or even a plant, may be considered for design purposes in the control of air pollution by providing for recovery and scavenging systems, sealed pumps, glands and valves, hoods, ducts, and pumps and other equipment which conserve products, minimize the human factor, and reduce air pollution potentials.

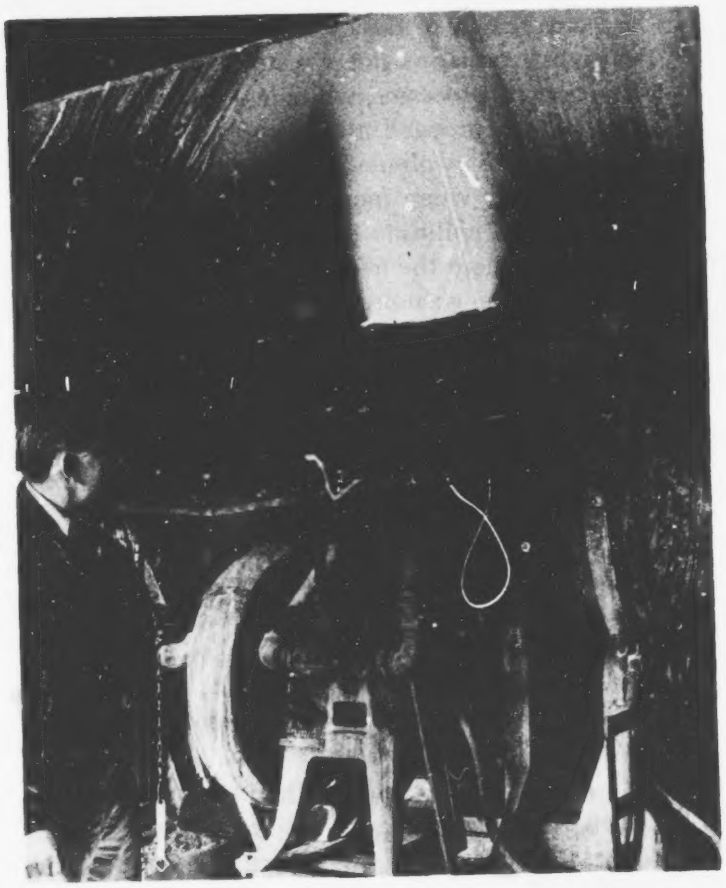

Figure II - 3. Reverberatory gray-iron furnace.

The effective design of basic production equipment and processes, it should be cautioned, may not succeed in controlling all types of air contaminants generated. Smokeless combustion equipment, for example, while reducing smoke, may still emit such contaminants as organic vapors, oxides of nitrogen, sulfur dioxide, and carbon monoxide. The accumulated emissions from a metal plant operating many efficient furnaces, or from the entire industry itself, may contribute significant amounts of air pollution. Continued improvements in the design to equipment, however, should increasingly result in compliance with community air standards.

3. Replacing or Altering Composition of Fuels or Materials

From the discussion in Chapter One, we have seen how the nature of the fuel economy of the metropolitan area becomes, perhaps, one of the most important causative factors in air pollution. Since the fuel economy is dependent on the fuels available, the choice of the relative smokeless fuels is limited in each fuel region. In the manufacturing belt of the United States, the choice of fuels is made among coals ranging from peat, lignite, and high volatile bituminous coals, through the lower volatile anthracite coal, or among the various processed coal fuels such as coke (volatiles removed), or pulverized coal (which can be atomized in burners like fuel oil). In the petroleum economy, fuels may range from heavy residual fuel oils with high sulfur content, to fuel oils and distillates with low sulfur content, or natural or liquified petroleum gases which are practically pollution free.

To meet control standards, combustion equipment employed is designed to compensate for the type of fuel used. Fuels with high amounts of impurities, including moisture, sulfur, and volatile matter, require equipment of more elaborate design in addition to careful operation and maintenance. Relatively smokeless fuels, such as coke, low sulfur fuel oil, and natural gas, on the other hand, only require combustion equipment relatively simple in design, and less operational and maintenance control.

The handling of the many types of process materials in industry follows a similar pattern. Materials with high vapor pressures, impurities, and wide ranges in boiling points, variations in particle size, toxic or corrosive components, etc., may be either replaced by other materials which do not have such properties, when they are available and practical for use, or they may be controlled by any of the other control techniques described here.

4. Control Devices

Whenever both design and operational efficiency are inadequate to control air pollution, specially designed control equipment becomes necessary. Control devices are equipment whose prime function is to control or collect contaminants, and which generally contribute nothing toward the economic objectives of production equipment. Thus operations in which air pollution is inevitable, such as melting of metal alloys with wide differences in volatility, the melting of impure or low grade metals, the melting of ores, and scrap materials, the handling of milling dusts, evaporation from large quantities of volatile materials, etc., require specially designed control devices.

Control devices are designed to prevent air pollutants produced from basic equipment from entering the air either by separating the contaminant from the air stream in which it is being conveyed and collecting it for disposal, or by destroying the contaminant by combustion at elevated temperatures and maximum combustion efficiency. These are usually installed in the stack or ductwork of equipment. In some cases the effluent is transmitted from production equipment to the control device by blower exhaust systems. In other cases, particularly gases, the effluent is motivated by draft pressures and diffusion. Control devices generally follow the basic equipment, and a single device can be applied to several or even a large number of equipment units by means of hoods and ductwork.

The classes of control equipment are divided between those which collect particulates and aerosols (solid and liquid forms) and those which collect or control gases.* Equipment used for the collection of aerosols and particulates is based on one or more of the following entrapment principles:

1. Inertial entrapment by altering the direction and velocity of the effluent.
2. Increasing the size of the particles through conglomeration or liquid mist entrainment so as to subject the particles to inertial and gravitational forces within the operational range of the control device.
3. Impingement of particles on impact surfaces, baffles, or filters.
4. Precipitation of contaminants in electric fields or by thermal convection.

The design of the device depends on the principle utilized and the following:

1. Size, weight, and shape of the particulate.
2. The inertial, settling, and filtration properties of the particles.
3. The grain loading and velocity of the effluent affecting the stream capacity of the device.
4. The temperature of the gas stream.
5. The physical form of the particulate (solid or liquid).

Generally speaking, the larger and more uniform the particle sizes, the cooler the exhaust gas, and the higher the grain loading or contaminant density, the simpler the control device. Effluent velocity is an additional factor, but optimum velocities vary according to the design and purpose of the device. The cut-off point between simple devices and more elaborate equipment, all other factors being equal, appears to be around 10 microns for particle size.

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* Control devices, as well as other control techniques discussed in this chapter, represent engineering practices beyond the scope of this manual. For further information, consult references 4, 5, and 11.

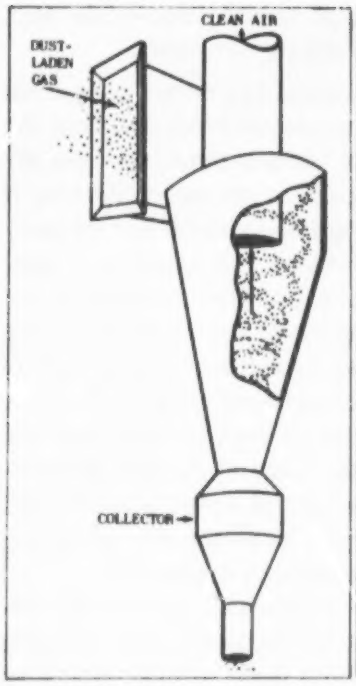


Figure II - 4. Flow of dust through cyclone.

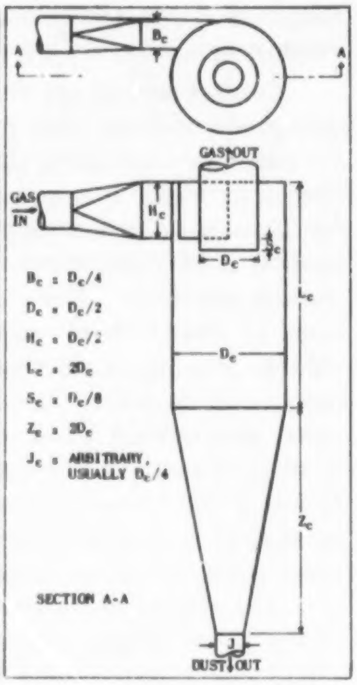


Figure II - 5. Diagram of cyclone separator.

With the exception of the combustion of volatilized gases, the collection of gases and vapors must usually be accomplished through a method which is specific to the physical and chemical properties of the individual gases. Gases may be absorbed into reactive solutions, collected by adsorption to an active surface area of a solid (such as activated carbon), condensed through temperature and pressure changes, reduced to carbon dioxide and water through high temperature controlled combustion, catalyzed to harmless substances, converted by chemical reaction to by-products, or conserved and re-used by means of vapor collection equipment.

a. Collectors and Separators

By utilizing the inertial properties of moving particles, a variety of collectors and air separators have been developed to remove dust particles from effluents and to collect them for disposal by other means. Collectors and separators are used widely to control dusts and fines from such mechanical operations as crushing, mixing, pulverizing, grading, blending, sanding, woodworking, milling, and in the handling of grain, feed, flour, sand and minerals.

The simplest of these devices is a settling chamber which sets lengthwise in the exhaust ductwork. As the dust-laden air enters the box, its velocity is suddenly reduced due to a drop in pressure, thereby causing contaminants to precipitate inertially. Although the collection capacity of settling chambers can be large, they are limited to the collection of dusts not smaller than 40 microns in diameter, and moving gas streams generally slower than ten feet per second. Some special settling chambers, utilizing shelves, have been built capable of collecting particles as small as 10 microns.

Centrifugal or inertial separators, frequently called *cyclones* because of the whirling, spiraling motion the air takes through the device, are quite suitable in collecting particles not smaller than 5 or 10 microns, although some efficient collectors have been developed which handle dusts as small as 2 microns in diameter. These devices are quite versatile and are easily constructed for a large variety of industrial situations.

The cyclone (Figures II-4 and II-5) is a closed device consisting of a cylinder on top of an inverted cone. Dust-laden air enters the top of the cylinder through a tangential duct. The velocity of the air, as governed by a blower motor in the ductwork, is sufficient to accomplish a spiraling downward movement, causing the particles to be separated from the air stream by centrifugal deflection. The particles slide down the walls of the cyclone into a hopper, while the cleaned gases escape through a tube at the top of the cylinder. Cyclones can handle large capacities of particles varying in size from 5 to 200 microns, at high velocities (generally from 30 to 25,000 cubic feet per minute). In fact, the greater the velocity of the dust-laden gas, the greater the centrifugal force applied to the particles, and the more efficient the collector. The smaller the diameter of the cyclone, the more efficiently particles are collected, although the steam capacity is reduced. Combinations of cyclones or multi-clones (see Figure II-6) can be used by first removing the

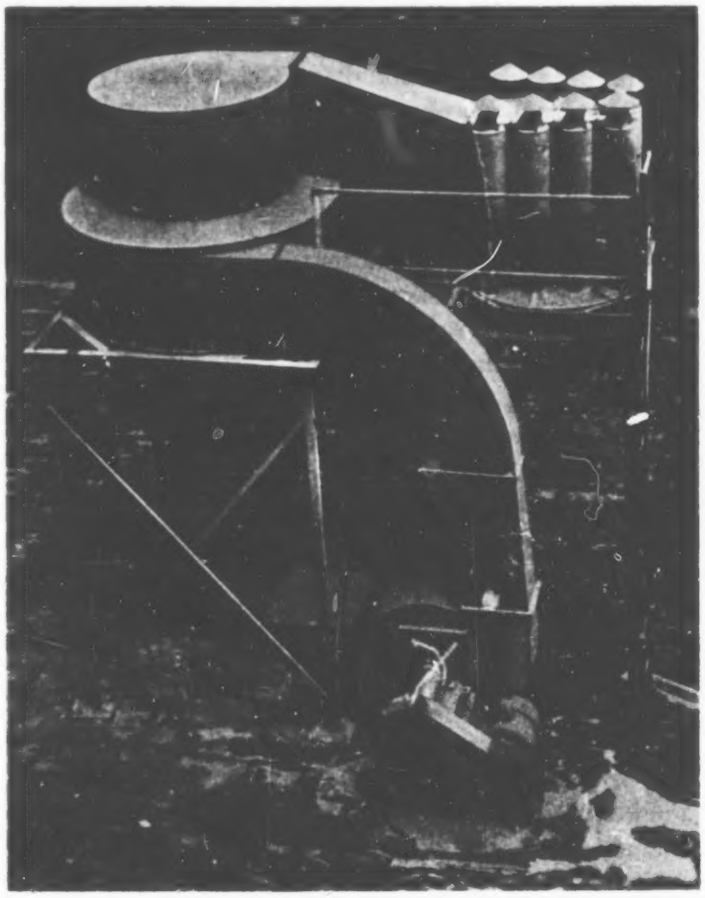


Figure II - 6. High-efficiency cyclone collecting system used to control dusts from flour mills. The large high-capacity cyclone is followed by eight low-capacity but highly efficient cyclone collectors.

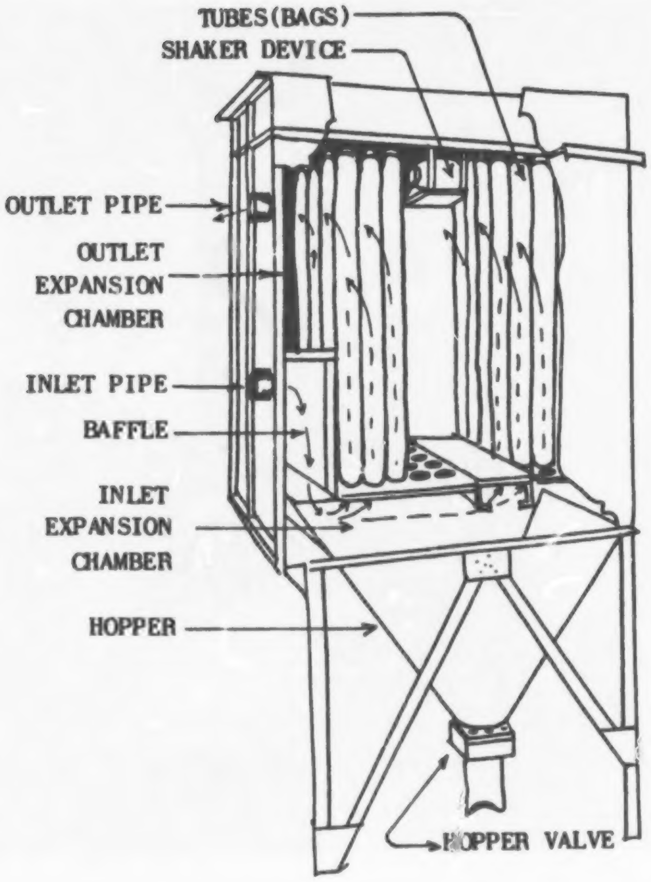


Figure II - 7. Simplified diagram of a baghouse.

Figure II - 8. Baghouse, non-ferrous foundry.

bulk of the larger particles in the large cyclones, and then collecting the smaller fines with the smaller cyclones. Cyclones, and even settling chambers can be used as primary collectors to be followed by more efficient devices, where particles in the effluent are extremely small.

Separation of liquid or solid particles from effluent air is also facilitated by building up particle size by means of a sonic collector to increase the effectiveness of inertial, centrifugal and gravitational collection devices(13). In the sonic collector, high frequency sound waves emitted from an acoustical horn create pressure oscillations on the dust-laden stream. The particles vigorously vibrate and hence collide and agglomerate. The heavier particles which result can then be collected through other means. Some collectors are effective for particles smaller than ten microns.

b. Filters

Filters (fibrous, cloth or viscous) are porous surfaces which entrap contaminants while permitting air to pass through them. The filter media may consist of cloth, orlon, dacron, silicon-treated glass fiber or any other suitable media. The filter media selected depend on the temperature of the exhaust gas, the durability desired, grain loading and capacity, and particle size. The critical factor is temperature, since high temperature gases are usually involved, particularly in metallurgical fume and smoke collection. Filter media made of cotton or wool cannot withstand temperatures greater than 280°F., whereas those made of silicon-treated-glass fibers can withstand temperatures in the neighborhood of 500°F. Hot gases, however, also must be cooled to the maximum operating temperatures of the filter media by quench tanks or cooling towers.

Filters with industrial applications generally take two forms: the *baghouse*, which is effectively used in many heavy metallurgical operations; and the screen collector. A typical baghouse is a box-like structure (Figure II-7) consisting of rows of tubular bags from 5 to 18 inches in diameter and from 2 to 30 feet in length, secured by their open ends to an inlet manifold or expansion chamber located either at the bottom or the top of the housing. The contaminant-laden air is conveyed by hoods and blower exhaust systems from the source of pollution, first to a cooling system, and then to a baffle plate in the expansion chamber, which deflects and precipitates most of the larger particles. The air is then forced through the bags and the particles are deposited on the inner surfaces. The accumulation of the collected contaminants forms a matrix which continues to increase the filtering efficiency of the device until the air can no longer pass through the pores of the material. The bags are periodically shaken or "flexed" either automatically or manually to dislodge the contaminants. The particles then drop through the inlet manifold into a receiving hopper. Baghouses of this type are extremely effective for most

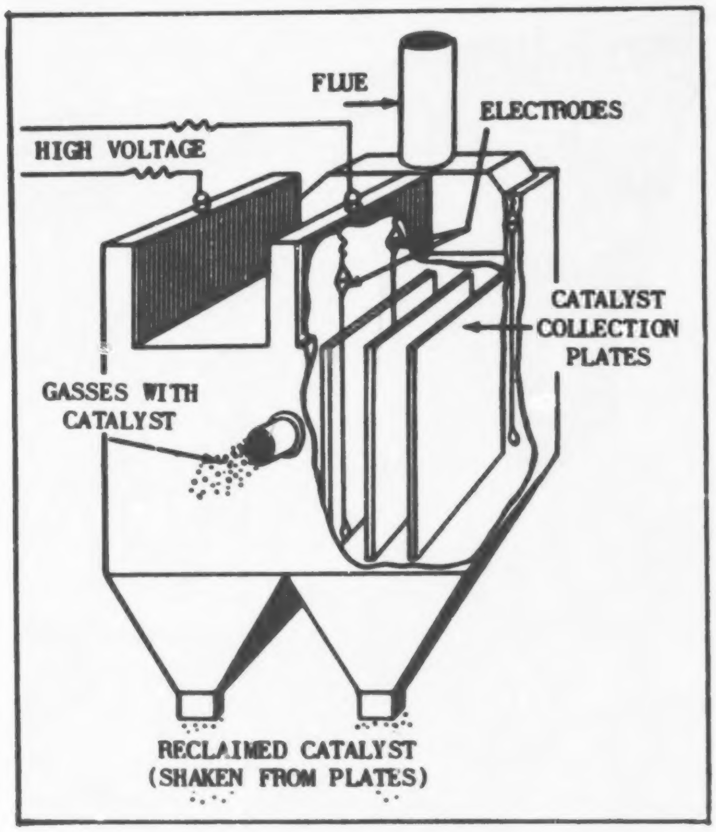

FLUE
ELECTRODES
HIGH VOLTAGE
CATALYST COLLECTION PLATES
GASSES WITH CATALYST
RECLAIMED CATALYST (SHAKEN FROM PLATES)

Figure II - 9. Diagram of plate-type electrostatic precipitator used to collect catalyst dust.

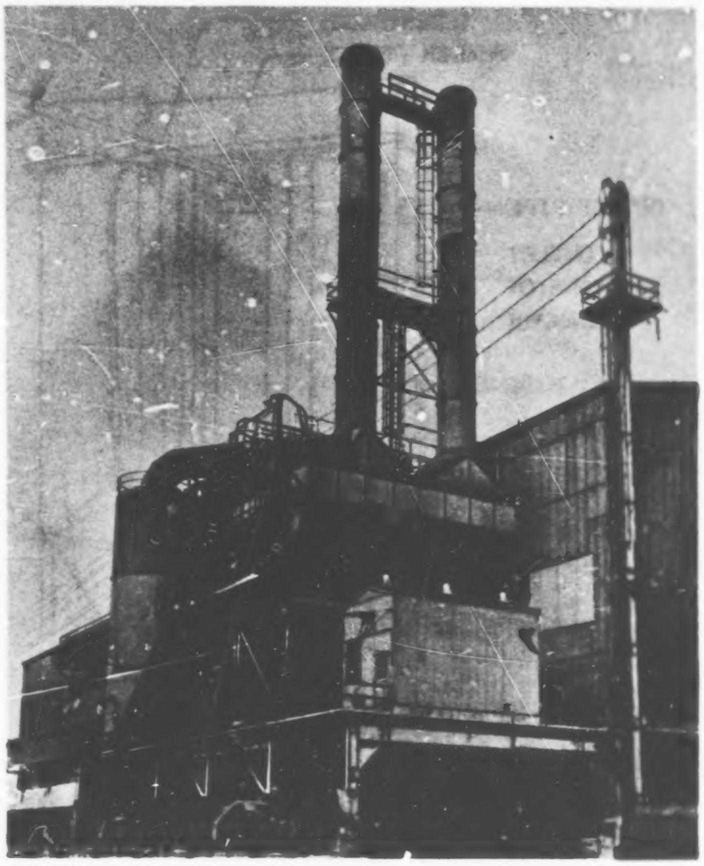


Figure II - 10. Heavy duty, single-stage electrical precipitator used to collect fumes from high capacity electric-steel furnaces.

heavy metallurgical operations, since they are capable of collecting fine metallurgical fume below 10 microns in diameter and at efficiencies exceeding 95%. In large volume steel operations involving open hearth furnaces, Bessemer processes, etc., however, difficulties are frequently encountered due to the high temperatures and gas volumes encountered.

Cloth-screen collectors are generally used to control dusts in smaller, intermediate industrial operations, such as tumbling, grinding, or abrasive cleaning. The collector generally comprises a series of cloth-covered frames set into a steel chamber. The device forces dust-laden air through the screens, which are replaced after use. Other filter media consist of packed fibres, filter beds, granules and oil-baths.

c. Electrical Precipitators

Although they are quite costly, electrical precipitators (Figure II-9) are perhaps one of the more effective control devices. They possess high collection efficiencies over a wide particle size range, low power requirements for moving large volumes of gases because of low resistance to flow, and they can be applied in industries with high air pollution potentials such as the metallurgical, refining and heavy chemical industries to collect metallic oxide fumes, catalyst dusts and asphalt and acid mists.

The electrical precipitator employs the principle of attraction of opposite charges. The particles in the contaminated exhaust stream are charged in a high voltage electric field and are then attracted to a plate of the opposite charge where they are collected. When the plate is shaken or rapped the pollutants drop into a hopper.

Electrical precipitators are capable of handling gases which are hot or cold, wet or dry and at gas temperatures as high as 1100° F., although temperatures usually range around 600° F. and lower. They operate best for the collection of particles less than .5 micron and for this reason precleaners such as cyclones and settling chambers are used to remove the larger particles and reduce dust loading.

Electrical precipitators are either of the single or dual-stage types. In the single stage, discharge electrodes are usually wires of negative polarity, and the collecting electrodes are either plates or pipes in which the discharge electrodes are hung. In the single stage types the collection is accomplished in a single electric field. These are used extensively for large industrial operations. In the dual-stage types, the contaminant particles are subjected first to an ionizing field, and then to a separate collecting field. These are used primarily in the air conditioning field.

Both types of precipitator run on rectified AC current, the single stage units at voltages of 25,000 and over (sometimes as high as 100,000 volts) and the two-stage units at about 12,000 volts in the ionizing section and 6,000 in the collection section.

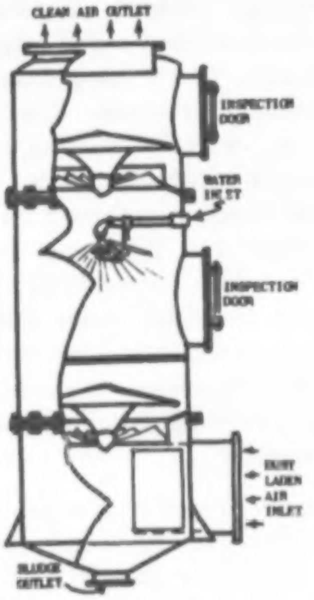


Figure II - 11. Centrifugal-wash collector.

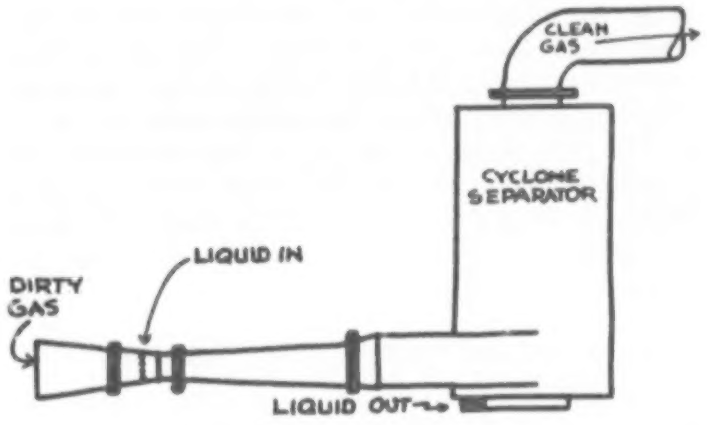


Figure II - 12. Venturi scrubber.

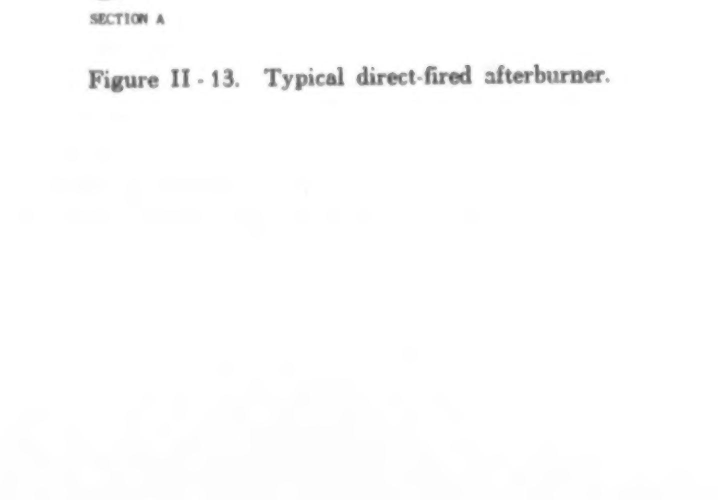


Figure II - 13. Typical direct-fired afterburner.

Figure II - 14. Tangentially-fired afterburner showning burner arrangement used in controlling air contaminants from varnish cookers.

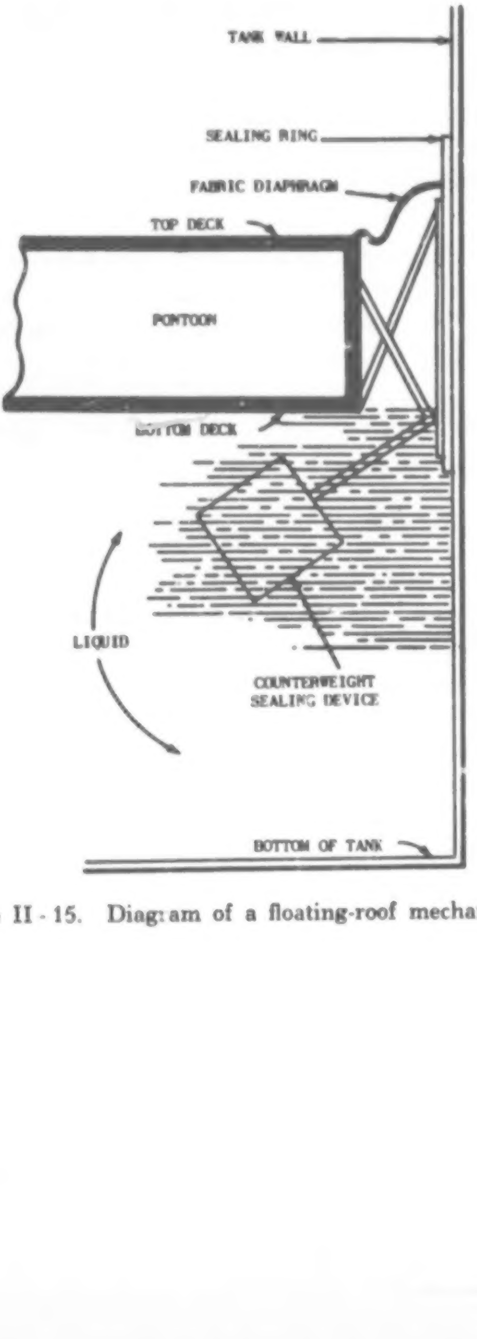


Figure II - 15. Diagram of a floating-roof mechanism.

d. Wet Collectors

These are various forms of washers, collectors, wet filters, centrifugal and venturi scrubbers (Figures II-11, II-12) which both clean and cool particle-laden gas streams by use of a high pressure liquid spray. This is accomplished in the various devices by atomizing the particle-laden gas stream at high velocities with droplets of water, thereby precipitating the contaminants. Most frequently water is used as the wetting agent; occasionally caustics are added for acid mist collection. Wet collectors are generally used to control particles forming as dusts, mists and fogs. According to the device, the collection range and efficiency are generally much greater than the cyclone, but considerably less than cloth filters or electrical precipitators. Efficiency will sometimes reach 99%, while the particle sizes collected may range, according to the device, from 40 microns to slightly less than 1 micron.

e. Afterburners

The afterburner (Figure II-13) has been applied in a wide variety of industrial situations to eliminate air contaminants and, consequently, varies considerably in design. Afterburners are capable of burning effluent gases creating malodors, and containing carbonaceous materials, fumes, organic vapors, particulate matter, smoke, hydrogen sulfide, carbon monoxide, or other contaminants. Their most significant use in Los Angeles County is in the abatement of malodors from refineries, rendering, paint and varnish, sulfur recovery, coffee roasting and fish processing plants. Afterburners are also employed to complete the combustion of smoke and particulate matter from incinerators in apartment houses and smokehouses in meat packing plants.

Afterburners operate at temperatures sufficient to ignite the contaminants. Temperatures may range from 900°F. to 1600°F, according to the material being burned, but usually at approximately 1200° F. The contaminated gases are mixed vigorously with a luminous swirling flame and are completely burned. Baffles in afterburners are used to produce turbulence and to slow the gases in the chamber to permit enough time for completion of combustion.

Some catalytic types of afterburners are also in use, especially on coater or lithographic ovens. In these afterburners, the contaminated gases are drawn by a blower through a preheat burner into a catalyst chamber containing a platinum coated ceramic teardrop. Here the temperature is catalytically raised and the gases are burned. Some of the cleaned gases are vented to the oven for heating, while the remainder of the gases is vented to the atmosphere.

f. Vapor Conservation Equipment

Conservation equipment is designed to capture vapors escaping from the storage and handling of gasoline or other volatile products. Vapors are created in the storage tanks of refineries and other processes due to increases in atmospheric temperature or from imbalances in refinery processes. Conservation is accomplished either by sealed floating roofs on storage tanks and oil-water separators, or by vapor recovery equipment. The floating roof rests on the surface of the liquid product and rises and lowers with the fluid level in the tank (Figure II-15). Floating roofs thus prevent tank breathing losses and the product is conserved directly in the tank. The floating roof is also applied to oil-water separator compartments to prevent breathing losses resulting from volatile materials in refinery waste streams.

In the vapor recovery system, the vapors are drawn from the fixed roof tanks to a vaporsphere (Figure II-18). A flexible diaphragm inside of the vaporsphere expands when the vapor pressure in the tank increases, and contracts when it decreases, very much like a lung. When the diaphragm expands to a predetermined height, a starter mechanism is actuated, and a compressor begins operation. The condensable vapors are then compressed into a liquid and the noncondensable gases are conveyed to fuel gas systems where they are used to fire boilers or they are incinerated in a flare. When the storage tanks are cooled by the atmosphere or the vapors generated from the process units decrease, the diaphragm drops to a point where the compressor automatically shuts off. Below this point, a vapor balance is maintained between the sphere and the tanks.

g. Gas and Vapor Collection Techniques

In addition to those gases and vapors which may be incinerated, or those which have a recovery value, gases and vapors may be collected through condensation, absorption and adsorption techniques. With the exception of absorption, these are essentially physical processes intended in one way or another to condense the gas from the vapor phase to a liquid which can then be handled for convenient disposal. In condensation, gas streams are compressed, cooled and adiabatically expanded. This technique by itself, however, is frequently impractical due to the energy required to bring the vapor to the dew point, especially when the vapors are in dilute concentrations as encountered in organic solvent emissions.(8) Although condensation through cooling and compression plays a part in gas collection equipment, the main emphasis is placed on absorption and adsorption principles of collection.

Absorption consists of the use of some substance which will selectively remove a gaseous or liquid material from another gas or liquid. Control is accomplished through gas-liquid contact devices either in cylindrical towers packed with an absorbing medium or spray towers which scrub the gas stream. For ex-

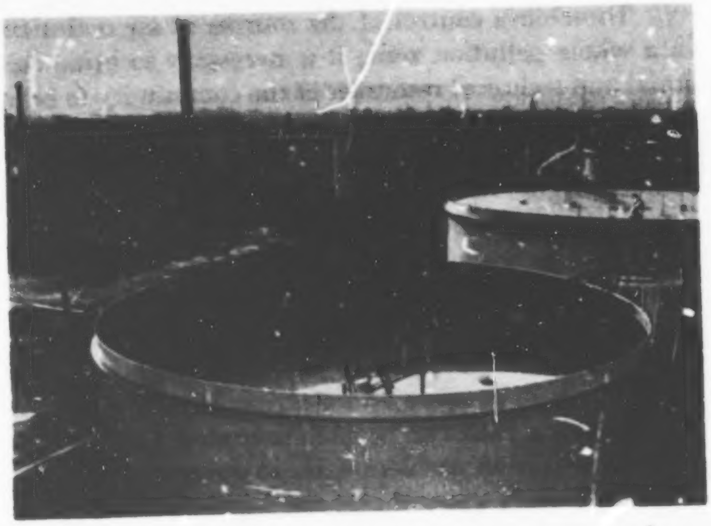


Figure II - 16. Floating roofs on petroleum storage tanks.

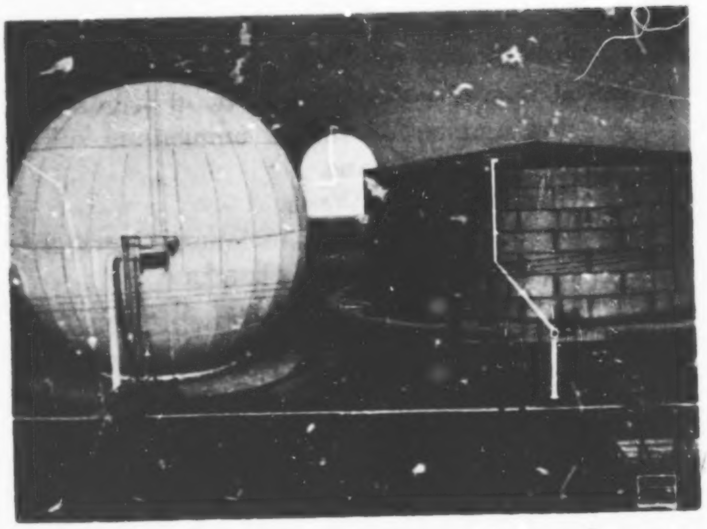


Figure II - 19. Vapor recovery system serving petroleum storage tanks.

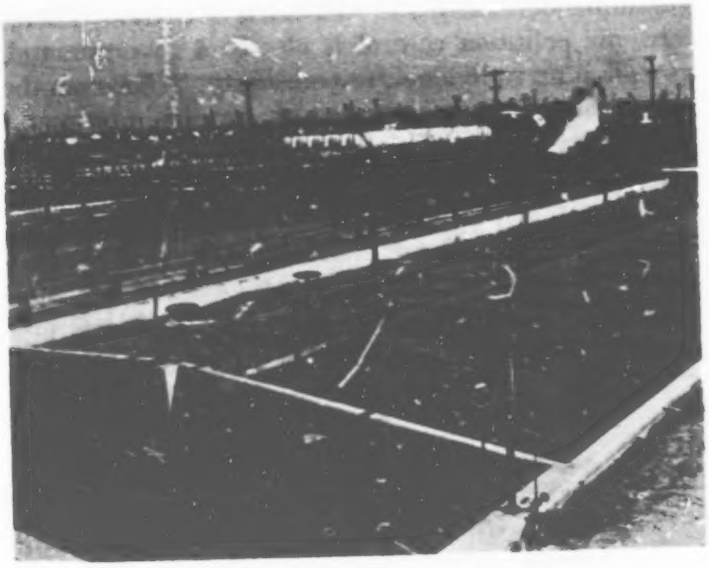
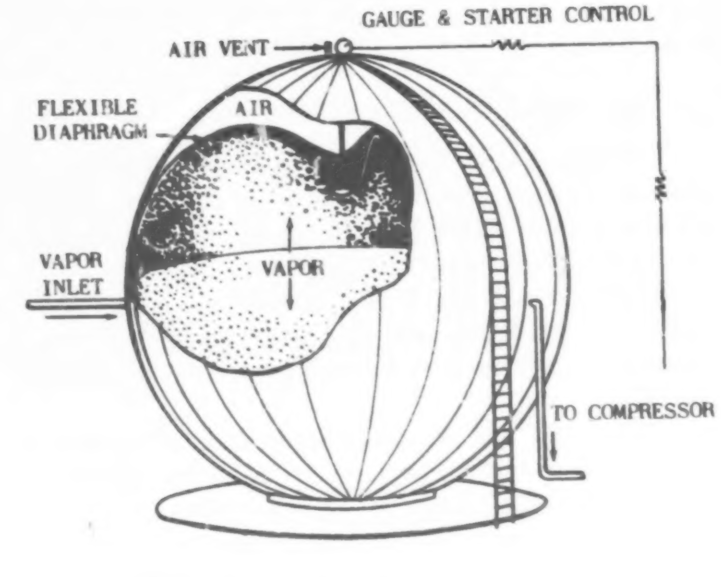


Figure II - 17. Covered oil-water separator.



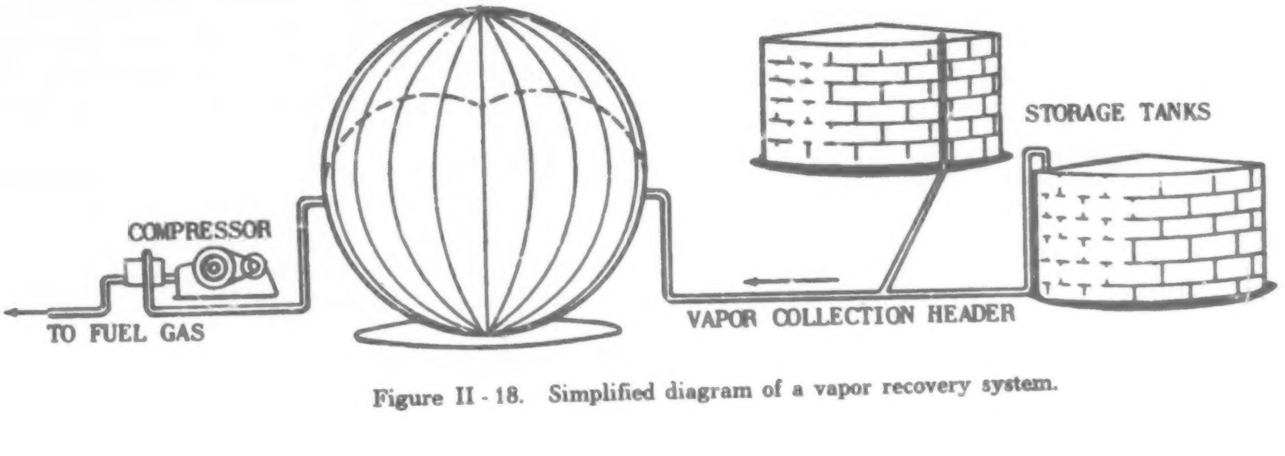


Figure II - 18. Simplified diagram of a vapor recovery system.

ample the following absorbing media are used for the gaseous contaminants specified:

Sulfur Dioxide—Water solutions of sodium sulfite, ammonium sulfite, ammonium sulfate and dimethylamine.
Oxides of Nitrogen—Water.
Hydrogen Sulfide—Diethanolamine, phenolate solutions, tripotassium phosphate.
Hydrogen Fluoride—Water and alkaline water solution.
Organic solvents—Mineral Oil, but not efficient due to need for control of low vapor concentrations.

Adsorption is a physical process in which the molecules of either a gas or a liquid are condensed on the surface of a solid material. Usually the capturing solid is a porous material with a specific affinity for the gas being adsorbed. Adsorbents include activated carbon, chars, gels, aluminas, and silicates. The adsorbent has a large surface area due to either the porosity of the material or capillary construction. Contaminant gases are brought in contact with the adsorbent and are collected in the pores or the capillaries. The adsorbent is regenerated by steam which drives off the adsorbed material in the form of a vapor which may then be condensed along with the steam and conveniently disposed of by other means.

II. AIR POLLUTION CONTROL PROGRAMS

Source control has long been practiced on an individual basis, either incidentally by improving plant efficiency, conserving fuels and materials, or directly in the practice of industrial hygiene and the promotion of community relations. Particularly is this true when industrial managers are not only aware, but keep themselves informed of air pollution control developments.

The control of all of the sources contributing to a community air pollution problem, however, cannot be left solely to the initiative and conscience of individuals, for a number of important reasons. First, the severity of the problem may dictate the need for comprehensive control of most, if not all, of the equipment in the important source categories. Second, it is economically as well as morally unjustified to permit one industry to operate without controls while a similar industry practices source control. Third, the degree of control practiced may be far below that required to achieve the necessary reductions in pollution potentials. Fourth, industries emitting contaminants which may appear harmless, but which have a subtle secondary pollution effect, may find no obvious need for control. Fifth, pollution problems result from the collective contribution of an industrial economy, even though individual source contributions may appear to be small. And sixth, individuals do not possess the resources to establish meaningful control standards.

To achieve control of the sources of air pollution in a whole pollution zone, it is necessary to bring the social and technical resources of the community to bear on the problem, either in the form of a volunteer association, or a governmental agency, or both. The initial purpose of such organizations is to establish objective equipment control standards scientifically predicated on the air quality desired and to investigate solutions to pollution problems.

Although private industrial, or trade associations or committees can promote effective clean-air campaigns, as well as serve as a clearing house for control developments, little can be done to control a severe and complex pollution problem without governmental participation. Only government can legislate and enforce control standards which will have a material effect on the entire pollution zone. Furthermore, only government, through elections, can reflect in its control activity the degrees of pollution reduction necessary to guarantee the health and well-being of citizens. Therefore, air pollution control is clearly a governmental, as well as an individual, responsibility. It becomes the responsibility of government to develop purposeful control standards which are certain, enforceable, apply to all, are based on demonstrable needs, and, at the same time, are not unreasonable, or capricious. The control agency, therefore, develops a control program suited to the needs and resources of the community. The typical elements of such a control program are as follows:

1. Identification and evaluation of both the community-wide air pollution or smog problem, and specific or local air pollution problems.
2. Establishing community air quality standards in terms of maximum allowable atmospheric concentrations, and promulgation of specific control standards which can be applied to control all of the equipment and activities responsible for air pollution.
3. Registration of the sources of air pollution in order to assess pollution potentials and to determine (1) the need for remedial or preventive measures, (2) trends in pollution potentials, (3) relationships between pollution potentials and atmospheric concentrations, and (4) objective criteria for anti-pollution legislation.
4. Enforcement of control standards simultaneously and continuously at all of the sources of air pollution in order to obtain minimum pollution potentials, as well as solutions to specific air pollution problems.

A. *Air Pollution Control Operations*

Air pollution control operations are the approaches taken to any air pollution problem by which all problems antecedent to actual institution of approved control methods are systematically attacked.

Control operations are intended to reach and inspect all of the sources of air pollution in the pollution zone in order to effect and assure their control. This requires not only the detection, apprehension and prosecution of those who flagrantly violate the control laws, but any other measures that will influence compliance and control, either through inter-agency and inter industry cooperation, or through public information and education.

The approaches to the different air pollution problems are dictated by factors which cannot be academically anticipated. An attempt to systematize control operations by an artificial classification of pollution problems based simply on contaminant, equipment source or industrial activity, will be defeated by unexpected factors. The approaches taken to accomplish control of the various categories of sources will thus be determined by the leading obstacles encountered. In this sense, air pollution control attacks *problems,* not industries. In Los Angeles County, some six types of control operations have been required, most of which are representative, in some degree, of practices conducted by other agencies. These are given here, with practical examples, as follows:

Agency Control Operations

1. Control of public sources — public information and education and inter-governmental cooperation (incinerators).
2. Control of an industry-wide problem (oil refineries).
3. Control of a key contaminant (Sulfur Dioxide).
4. Control of the industrial sources of air pollution (general source control program).
5. Control through trade associations.
6. Development programs for uncontrolled sources.

1. Control of Public Sources of Air Pollution

Frequently the full force of public opinion is directed at the obvious sources of air pollution, such as smoke and inefficient combustion equipment. The improvement of coal quality and the installation of smokeless combustion equipment by industrial, commercial and domestic users in St. Louis and Pittsburgh are classic cases in point. However, when the sources of air pollution are not so obvious, as in the case of Los Angeles, the control emphasis may not be so clearly indicated. In complex problems, the control authority must not only vigorously investigate the problem, but must inform the public adequately. It has been particularly fortunate in the Los Angeles experience that public pressure, in so aggravating a problem, could be channeled into intelligent and creative control programs.

The Los Angeles problem was complicated initially by the reluctance on the part of the community to accept its share of the responsibility for air pollution. The popular assumption that "smog" arose from oil refineries and chemical plants obscured the fact that all sources of air pollution contributed to the problem. The control program of the A.P.C.D. sought control, therefore, of not only industry and refineries, but of the public sources — some million and a half single-chamber incinerators and, inevitably, the automobile, now the major uncontrolled source of air pollution.

The burning of domestic, commercial and industrial rubbish in Los Angeles County became a problem not only because of the large number of incinerators, which emitted about 500 tons a day of smoke and combustion contaminants, but also because incinerators created a heavy complaint load, requiring the fullest attention of the A.P.C.D. Public support was necessary before backyard burning could be abolished. The elimination of the backyard incinerator and all other inefficient industrial and commercial single-chamber incinerators was the only means of certain control. Various communities within Los Angeles County, furthermore, demonstrated the feasibility of collecting and disposing of rubbish through other means. Action to abolish incinerator pollution was undertaken in the following manner:

1. A public information program was designed to inform the public of the role of the refuse burning in the smog problem, and of the feasibility of abolishing the use of the single-chamber incinerator.
2. A program of inter-governmental liaison and cooperation to secure cut-and-cover dumps and adequate rubbish collection services in the more than 50 cities and other unincorporated areas of the County was instituted.
3. Efficient multiple-chamber incinerators to dispose of production wastes or dwelling refuse with a minimum of smoke pollution were developed to meet stringent burning regulations.

The preponderance of the initial control effort was spent in the public information program. It was necessary for the public to be conscious of the effect of the mass use of incinerators on the atmosphere. When the public was fully apprised of the facts through the media, its elected representatives were prepared to take the necessary steps. Incinerators were then banned by regulation everywhere in Los Angeles County.

2. Control of Industry-Wide Problems — Oil Refineries

Occasionally, an industry-wide problem will occur requiring a planned and concentrated control effort. The oil refining, metallurgical, and animal rendering industries are typical of such problems. Where the industry presents a wide range of complex sources of air pollution, the problems within each industry are classified and attacked systematically. The petroleum refining industry, particularly in Los Angeles, is the most complex of such industries.

The oil refining process consists of rearranging hydrocarbon molecules obtained from crude oil to produce a variety of petroleum products including aviation and automobile gasolines, Diesel and industrial fuel oils, domestic heating oils, lubrication oils and greases, kerosene, asphalt and coke, hydrocarbon gases, solvents, and a variety of specialty products. The rearrangement and modification of hydrocarbons is accomplished by any one or combination of the following processes:

Figure II - 20. Residential rubbish pick-up truck with compacting unit.

1. Distillation — separation of hydrocarbon molecules according to boiling range and type in stills and fractional distillation columns.
2. Cracking — breaking down of large complicated molecules into different compounds in thermofor or fluid catalytic cracking units.
3. Polymerization — joining together smaller hydrocarbon molecules to form larger molecules in polymerization units.
4. Hydrogenation and dehydrogenation — altering the hydrocarbon structure by adding or removing hydrogen in hydrogenization and dehydrogenation units.
5. Alkylation — substituting or adding an alkyl group such as methyl or ethyl.
6. Isomerization — rearranging molecular structure of hydrocarbon molecules without changing chemical formula to develop new properties in compounds.
7. Reforming — cracking of hydrocarbon to increase octane rating or to produce aromatics and paraffins from olefins in reforming, Hydroforming or Platforming units.

Virtually all of these processes are conducted catalytically at high temperatures and pressures in suitably designed equipment, or by thermal processes as in distillation and some cracking processes. Petroleum stocks are also extensively handled, treated, blended, stored and marketed. Virtually every phase of petroleum production, recovery of waste products, refining and marketing possesses pollution potentials including emissions of saturated and unsaturated organic vapors, sulfur dioxide, hydrogen sulfide, oxides of nitrogen, carbon monoxide, catalyst dust, and visible smoke plumes. These may occur anywhere from the feeding and processing of stocks to the storage and handling of final products and the disposal of waste water streams. In Los Angeles County legal requirements and voluntary action by the petroleum industry have resulted in comprehensive control of emissions to an extent not known elsewhere. The local refinery problem has also been studied intensively to determine the full nature and extent of the refinery contribution, and to indicate further control needs through a joint project of the Los Angeles Air Pollution Control District, the U. S. Public Health Service, the State of California Department of Public Health and the Western Oil and Gas Association.(8)

The air pollution problems and the solutions applied are described below.

1. PROBLEM: Carbon monoxide, oxides of nitrogen, oxides of sulfur, hydrocarbon vapors, catalyst dust plume and visible plume from coke and other deposits from catalyst regenerators and cracking units.

   CONTROL: Electrical precipitators and centrifugal collectors for catalyst dust collection and waste-heat boilers for combustion of carbon monoxide and other contaminants.

2. PROBLEM: Black smoke from emergency flares used to burn excess gas surges created by upset or abnormal refinery operations.

   CONTROL: Redesign of flares using either Venturi burners to obtain suitable fuel-air ratio, or introduction of steam injection into the combustion zone.

3. PROBLEM: Vapor losses from storage tanks.

   CONTROL: Vapor collection system or floating roofs on storage tanks to prevent evaporation of volatile products.

4. PROBLEM: Malodor and hydrocarbon emissions from oil-effluent water separators (separate oil from waste waters).

   CONTROL: Completely enclosed separator boxes with suction lines and compressor to remove vapors to absorption tower, or floating roof covers with automatic skimming devices, or covers over inlet compartments in oil sumps.

5. PROBLEM: Hydrocarbon vapor losses from large volume loading of gasoline into tank trucks.

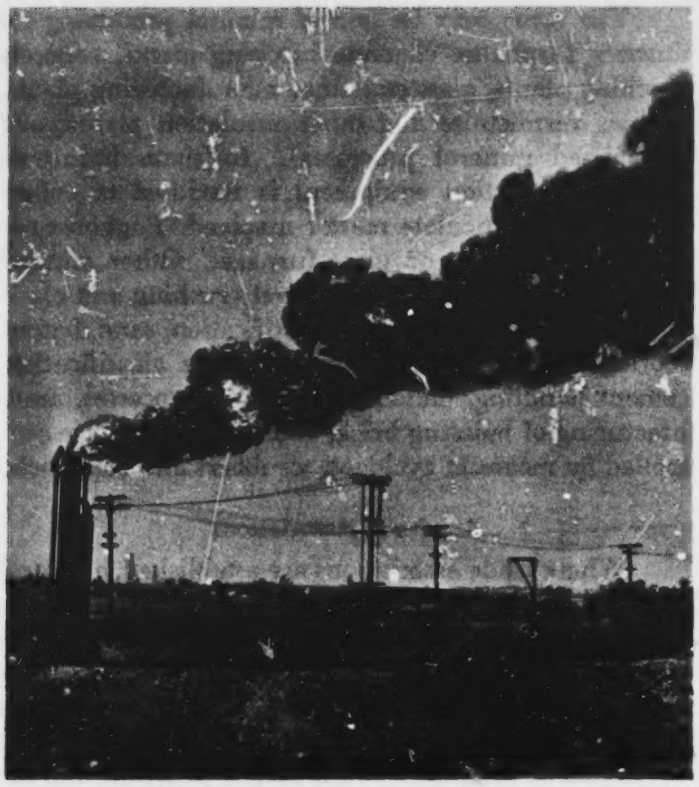


Figure II - 21. Smokeless flare with control equipment not in operation.

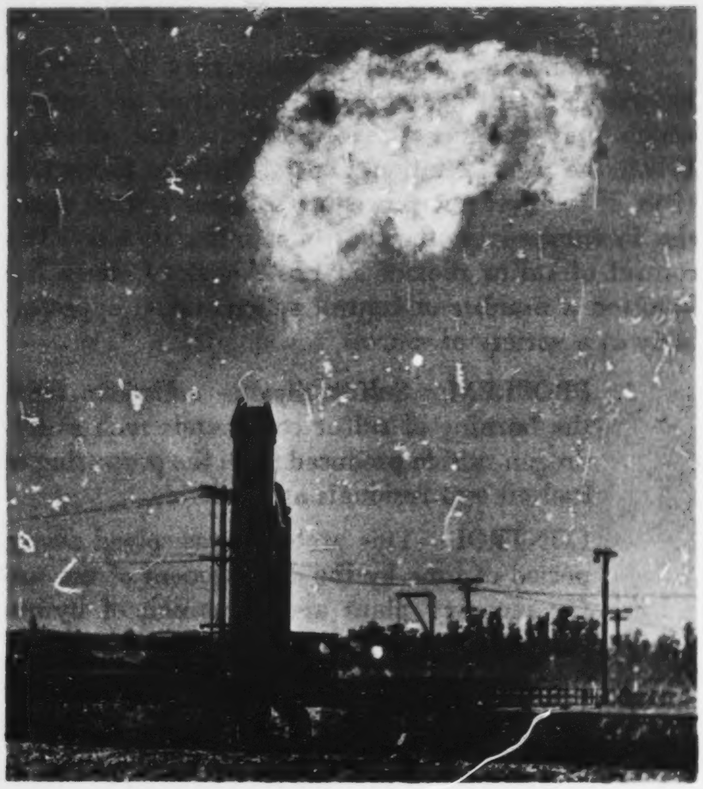


Figure II - 22. Smokeless flare system for emergency gas releases with control equipment in operation. Controls regulate quantity of steam to the flares for varying gas flows.

CONTROL: Vapor tight fittings and seals for loading arm adaptors and vapor collection equipment.

6. PROBLEM: Smoke from boilers and heaters in refinery processes.

   CONTROL: These are controlled primarily through effective operational and maintenance practices, and proper design of fireboxes, burners, and controls.

7. PROBLEM: Hydrocarbon vapors from vacuum jets associated with vacuum distillation facilities.

   CONTROL: Effluent from final stage of processes is controlled by condensation and collected in a closed settler for separating the water and hydrocarbons. The non-condensable vapors are burned in an afterburner, furnace or boiler, or are added to refinery fuel gas systems.

8. PROBLEM: Light hydrocarbon vapor losses from centrifugal pumps with packed gland seals.

   CONTROL: Conversion to mechanical seal pumps, and enforcement of inspection and maintenance procedures.

9. PROBLEM: Hydrocarbon losses from accumulator vents and relief valves and other processes.

   CONTROL: Vented to vapor collection equipment or waste heat boilers.

10. PROBLEM: Malodors from processing of sulfur compounds, acid treating, doctor treating, mercaptan removal processes, caustic regeneration, cresylic and naphthenic acid manufacturing and air blowing of asphalt.

    CONTROL: Burning malodorous vapors in a combustion chamber or boiler firebox at 1200°F.

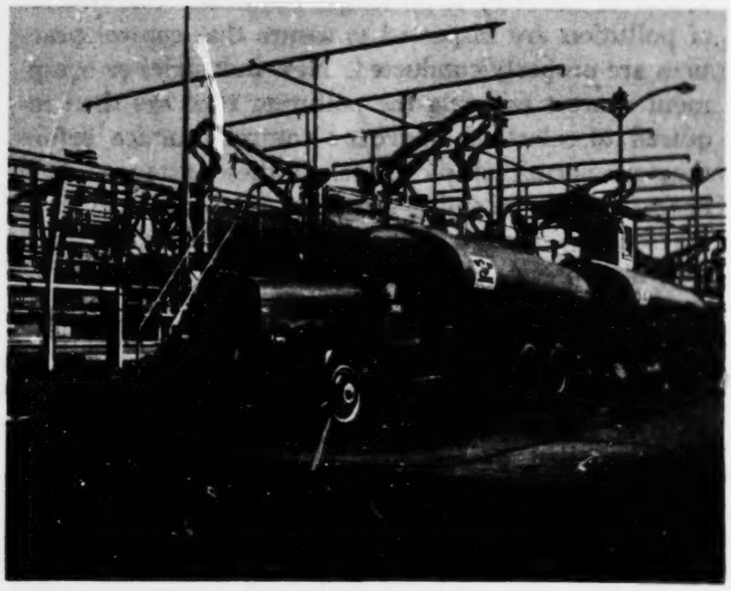


Figure II - 23. An open overhead controlled loading rack showing Greenwood vapor closures on the pneumatically operated loading arms.

3. Control of a Key Contaminant — Sulfur Dioxide

Sometimes a control program may be directed toward a specific contaminant, and all of the sources which may produce it, regardless of the industry. When the Air Pollution Control District formed in 1948, it followed the procedure of other control agencies in emphasizing the control of sulfur dioxide. The control of sulfur dioxide in Los Angeles County has involved a number of control actions taken appropriately at a variety of sources.

1. PROBLEM: Sulfur dioxide emissions from the burning of sulfur compounds such as hydrogen sulfide produced from the processing of fuel oil and residuals at refineries.

   CONTROL: This problem was solved over a period of time by the development of the sulfur recovery plant and expansion of hydrogen sulfide facilities in the refineries.

2. PROBLEM: Sulfur dioxide emissions from fuel oil burning in heating and processing boilers, and from large steam-electric generating facilities.

   CONTROL: This problem has been partially solved by rule prohibiting the burning of fuel oil during certain months of the year; in effect, requiring the use of natural gas. Studies continue, however, to seek means of eliminating air contaminants from power plant flue gases by electrical precipitation and other means.

4. Control of Industrial Sources of Air Pollution

Once air pollution problems from any source or industry are solved by proven control techniques, and all other obstacles to control have been eliminated, then a special control program for that equipment source or industry is no longer required. The sources of pollution are inspected to assure that control practices are properly conducted. New industries or equipment sources entering the pollution zone are then required to select an approved control practice before they are permitted to operate. In these instances, field operations are intended to insure continued control of the sources. In Los Angeles County all such routine control processes are systematized and are known as the Industrial Source Control Program.

An example of such routine practices may be found in the metallurgical and mineral processing industries. In the metallurgical industry, control is directly applied, as required, in the form of cyclones, baghouses, scrubbers, electrical precipitators, or by change-over to improved furnaces and equipment. Each problem, however, is studied for such factors as temperature, equipment layout, and variations in the quantity and sizes of particle emissions before successful control is accomplished.(1)

The same may be said of mineral processing industries (asphaltic concrete batching plants, concrete batching plants, glass container manufacturing plants, perlite, vermiculite and other insulation plants, and specialized mineral processes). In these industries standard collection equipment is modified to collect the specific particulate matter involved. Baghouses or scrubbers are used on glass furnaces. Other mineral processes, such as rock and gravel crushing and classification, mica grinding and classification, sand drying, roofing granule plants, silica abrasive classification, cement handling, diatomaceous earth processes, manufacturing of building brick, and many others are controlled by means of cyclones, scrubbers and baghouses.

5. Trade Associations

Where trade associations are established, a control program may be instituted through cooperative action. Early in the control program of the Air Pollution Control District, equipment manufacturers and designers from the metallurgical industries, in cooperation with A.P.C.D. engineers, established a control equipment development program. From such a program, the development and use of the first effective high temperature gas filtration equipment for the collection of emissions from gray iron cupolas was developed. This same equipment has not only since been refined, but has found wide application in many industries.

6. Air Pollution Control Development Programs — Automotive Exhaust and Organic Solvents

When the means for controlling a source of a major air pollutant are not available, then the control agency must attempt to promote their development. This is accomplished by means of a control development program with the following features:

(1) adequate research on the pollution problem in question, so that the importance of the air contaminant can be ascertained;

(2) development and substantiation of the data characterizing the nature of the problem, so that development of control techniques can begin from valid assumptions;

(3) promotion of engineering control development projects; and

(4) testing of control devices or techniques as they are developed for efficiency to determine control standards.

When control devices and techniques are developed and approved, legislation may then be promulgated, and control action instituted.

In Los Angeles County two such developmental control programs are currently conducted. These concern the emission of unburned gasoline products from automobiles and the emission of organic solvents from a variety of industries.

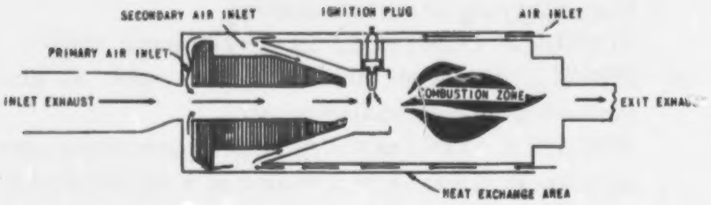


Figure II - 24. Ignition type exhaust afterburner. Unburned hydrocarbons are consumed as they pass through this exhaust muffler where they are mixed with fresh air and ignited by a spark or flame.

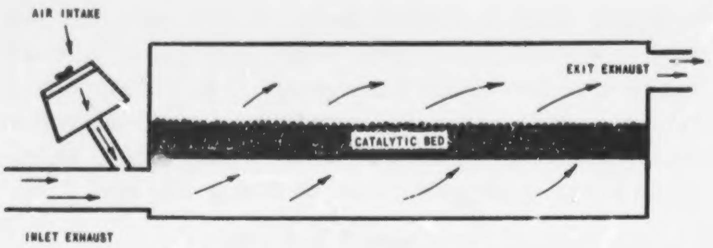


Figure II - 25. Catalytic type muffler exhaust afterburner. Unburned hydrocarbons mixed with fresh air pass through a catalyst bed where the smog-forming hydrocarbons are destroyed.

a. Automobile Exhaust

Since auto exhaust control methods were not available at the time that the importance of the automobile exhaust problem was first established, it was necessary to explore all possible avenues of control. Control concepts explored were based on (1) eliminating all unburned gasoline products, whether saturated or unsaturated, through all operating cycles of the automobile engine; (2) eliminating all unburned gasoline products during those operating cycles only in which the majority of the unburned gasoline is exhausted; and (3) eliminating only key reactants, such as the olefins and/or the oxides of nitrogen. Some of the following devices and control methods have been developed or are currently under consideration.

1. Direct-flame afterburners with or without an ignition device for burning unburned contaminants in the exhaust.
2. Catalytic mufflers which oxidize the unburned contaminants in the exhaust.
3. Fuel cutoffs which function to prevent fuel flow to the engine during the deceleration cycle.
4. Vacuum-limiting devices which allow sufficient air to enter the intake manifold to effect more efficient combustion during the deceleration cycle.
5. An oxides of nitrogen reducer utilizing a reducing agent such as vanadium pentoxide to convert oxides of nitrogen into oxygen, nitrogen and carbon monoxide.
6. Reduction of nitrogen dioxide by recirculating a small amount of cooled exhaust to the engine.
7. Recirculation of "blowby" emissions from crankcase to the intake system.
8. Modification of gasoline composition to reduce smog-forming effects of unsaturated hydrocarbons principally by reducing olefinic content of gasoline.
9. Reduction of automobile traffic by implementing rapid transit systems.
10. Modification of power plant, so as to eliminate or minimize the emission of contaminants.

The development of many of these techniques and devices has progressed to a point where practical control is now imminent, not only in Los Angeles County but, eventually, throughout the country. Automobile manufacturers, private research and development groups, as well as individuals, for the last five years have been intensively developing and refining a number of promising devices. The automobile exhaust laboratory of the Los Angeles County Air Pollution Control District, the first of its kind, has been testing these devices, as well as researching the problem to determine control standards.

The specific objective in controlling automobile exhaust is to certainly control the olefins, oxides of nitrogen and carbon monoxide at such efficiencies, as to avoid a backsliding of pollution to pre-control levels due to increasing automobile population. The control of auto exhaust, therefore, cannot be partial. To insure complete control, several approaches are being taken. The first of these is the control of olefin content of gasoline, and the second, the direct control of auto exhaust emissions.

In Los Angeles County gasoline composition is regulated by Rule 63 of the A.P.C.D. which prohibits the sale of gasoline for motor fuel having a Bromine number of more than 30 (13%) after June 30, 1960, and a Bromine number of 20 (12½%) after December 31, 1961. After the latter subdivision of the rule becomes effective, a 75% reduction in smog-forming olefins is expected.

The direct control of automobile exhaust emissions is now possible by virtue of the devices mentioned. The primary consideration at the present time is the cost and efficiency of such devices. Air quality standards, as set by the California Department of Health, require that they accomplish an overall 80% reduction of hydrocarbon emissions, and a 60% reduction of carbon monoxide.

On April 15, 1960, the California State Legislature passed Assembly Bill No. 17, requiring the installation of control devices on all cars throughout the entire state, with the exception of those counties of the state which demonstrate through public hearings that no pollution problems exist. The law further requires that, upon the certification of at least two proven devices by a Motor Vehicle Pollution Control Board, all new vehicles, when first registered, and all used vehicles which change ownership, must be equipped with a control device within one year, all used commercial vehicles within two years, and all motor vehicles within three years. The entire control of automobile exhausts, therefore, is now subject to the certification of control devices, and control development and testing continue to hasten this end.

b. Organic Solvents

The air pollution problem presented by the emission of many solvents used in industrial, commercial and domestic activities carried on in Los Angeles County has posed a problem similar to that of the automobile exhaust. The existence of this problem was theoretically assumed on the basis of experience with automobiles and refineries, and substantiated by surveys and other statistical findings. It was determined that some organic solvent vapors, including alcohols, ethers, paint thinners and lacquer thinners, react in the Los Angeles atmosphere to produce smog in the same manner as gasoline vapors. Recent estimates indicate that about 500 tons per day of these solvents are discharged into the atmosphere (See Chapter 1).

The problem of controlling organic solvents involves questions similar to those posed by the automobile. Is it sufficient to eliminate only the most reactive unsaturates or must all of the contaminants produced by the complex of activities using organic solvents in one form or another be controlled? The final decision in this regard is dependent upon research which must determine the relative importance of all contaminants and the means available to control them upon development of controls at a cost which can be met by small users, the establishment of reasonable standards and the development of suitable methods for measuring vented contaminants.

Since solvents vary and are used under a wide variety of conditions from paint thinner to metal degreasing — each particular type of industrial user encounters a different problem. To comprehend the differences, control development concerns these problems.9)

1. PROBLEM: Gases with high concentrations of hydrocarbon solvents.

   POSSIBLE CONTROL: Catalytic afterburners and direct-fired afterburners. Catalytic afterburners have been applied to lithograph ovens, and direct-fired afterburners have been installed on paint baking ovens, varnish thinning tanks and other equipment where high solvent concentrations may be expected.

2. PROBLEM: Solvent emissions (chlorinated hydrocarbons) from dry cleaning plants.

   POSSIBLE CONTROL: A packaged activated carbon adsorption unit adaptable to certain small operations. This unit is economically attractive to the user.

3. PROBLEM: Losses of solvents with low concentrations of hydrocarbons which result primarily from spraying or surface coating.

   POSSIBLE CONTROL: In development stage.

4. PROBLEM: Dilute solvent vapors such as are emitted from rotogravure presses.

   POSSIBLE CONTROL: A large regenerative absorption unit has been installed as a voluntary air pollution control measure on a rotogravure press. This unit has a design capacity for the removal of 1800 pounds per day of ketones, ethers and alcohols. Removal efficiency is about 99 per cent.

5. PROBLEM: Chlorinated hydrocarbons emitted from metal degreasing units.

   POSSIBLE CONTROL: In development stage. An adaptation of activated carbon adsorption techniques is being investigated.

These represent a few of the many problems involving organic solvents. There are also many installations in Los Angeles County emitting more than 10,000 pounds per day of solvents which could be controlled through adsorption recovery. When all solvent losses can be feasibly controlled, regulations will be adopted.

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CHAPTER THREE

THE LAW OF AIR POLLUTION CONTROL

The right of a society to prohibit and to regulate the sources of air pollution is firmly established in legislative and judicial precedent and in the police power delegated to the states by the Federal Constitution. Political organizations, from the municipality to the state, possess the full power to legislate and enforce air pollution control laws as long as the control of air pollution is technically feasible and reasonable. Severe measures can be lawfully adopted as they become necessary, provided that they are not arbitrary and capricious. Moreover, the statutory control of air pollution is not limited to correction of existing conditions, but can be applied in a flexible and farsighted manner to prevent pollution hazards, disasters, or worsening pollution trends. The legal control of air pollution is no different in these respects from any other form of statutory and administrative law designed to protect the health and welfare of the public.

Air pollution control law, however, is unique in terms of the abstract nature of air pollution. Because law regulates the conduct of individuals, and air pollution results from collective acts which are otherwise individually lawful, air pollution law does not appear to be morally or criminally self-evident. Air pollution control law is essentially the adaptation of legal concepts to scientific evidence and standards designed to achieve gross reductions of air pollution potentials.

Although violations of air pollution law may result in criminal action, the basic intent of the law is to achieve standards of compliance on the part of the sources of air pollution, not to punish for its own sake. Air pollution law takes into account the technical nature of air pollution and the fact that actual control is achieved, in the last analysis, by cooperation on the part of the community, industry and individuals. Law is thus one of the many tools used in the control of air pollution.

I AUTHORITY AND PRECEDENT FOR LEGISLATIVE ENACTMENTS

Although the law concerning air pollution is complex, a few basic legal principles underlying the capability of a community to enact valid laws to prevent air pollution can be stated. These will be discussed in terms of (1) common law nuisances, (2) constitutional powers and limitations, and (3) recent case law.

A. Common Law Nuisances

Both the nuisance value and the criminal aspects of air pollution have been derived from the exposition of the concept of the "common nuisance" and, particularly, the "public nuisance" at common law. In England early common nuisances involved encroachments and infringements on the royal domain of the crown and by the time of Edward III, many acts resulting in air pollution were included.[a] The concept was later extended to include any form of annoyance or inconvenience which interfered with common public rights. The public nuisance has been numerously and variously defined, but most definitions and statutes concerning public nuisances were later worded in terms of any act or omission which offended the health, comfort, welfare, morals, safety, etc. of the public. A public nuisance, for example, is an act or omission "which obstructs or causes inconvenience or damage to the public in the exercise of rights common to all Her Majesty's subjects."[b] Public nuisances resulting from such specific forms of air pollution as smoke, fumes and odors were contained in a class with other minor criminal offenses in the common law and were classed as misdemeanors.

Each nuisance case, therefore, was tried on its own merits. Historically, the problem of air pollution was not immediately considered as a nuisance *per se*, that is, a nuisance in and of itself. Cases of public nuisance arose as a result of complaints made by citizens in a community against a source or sources of air pollution.

In modern times, the increasing use of the term "air pollution" rather than smoke, odors, fumes, etc., reflects acceptance of the judgment that anything which contaminates the air in a crowded community is detrimental to the public welfare, just as the contamination of drinking water, or the industrial pollution of streams, is so considered. "Air pollution" came to be regarded as an "absolute" nuisance. Thus, under the police powers of the state, specific air pollution problems are declared by statute, within constitutional limitations, to be nuisances.[c]

Because of their uncertainty, however, public nuisance statutes were inadequate to form the sole basis for air pollution control law in modern communities. Therefore, laws were written limiting the emission of specific contaminants, either by setting maximum permissible pollution standards or by regulating the use and operation of equipment and fuels. The first such ordinance giving specific authority to local government to regulate smoke discharge in the United States appears to have been adopted in Chicago in April, 1881. Cincinnati and St. Louis soon followed, and by 1913, 23 out of 28 cities with more than 200,000 population had smoke abatement programs involving ordinances against specific contaminants.[d] Thus, under authority of the state legislature, definite control standards were established for specific types of air pollution problems, such as smoke, and the problem of air pollution was systematically attacked without the necessity of proving in each case a statutory or common law nuisance.[e]

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[a] Prosser, W. L. See reference 12, p. 390. Chapter 14 traces the history and case law of the various forms of nuisance and is fundamental to the subject.

[b] Ibid, p. 401, from Stephen, *General View of the Criminal Law in England*, 1890, 105.

[c] Ibid, page 400.

The control laws enacted in the United States are of two principal types: (1) punitive ordinances which impose fines for discharging contaminants into the air; and (2) regulatory ordinances which seek to abate air pollution by preventing the discharge of contaminants into the atmosphere. The validity of these laws depends entirely upon whether or not they come within constitutional limitations and, in the case of a city, its charter or constitutional provisions to pass such laws.[f]

B. *Constitutional Powers and Limitations*

In essence, the Constitution of the United States contains no provision which prevents the enactment of air pollution control acts in the states. The police power of the state, that is,the power to protect the health, morals, safety and welfare of the citizens, is derived from the Tenth Amendment of the Constitution,which states:

> The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.

The power to control air pollution, to all intents and purposes, lies exclusively with the states. The limitation in the amendment is imposed on the federal government in that the federal government has no general power to enact police regulations within the territorial limits of the states.[g]

The only other constitutional limitation to this police power is contained in the Fourteenth Amendment of the Constitution,as follows:

> .... nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the protection of law.

This particular amendment determines the extent to which air pollution control law can go.

C. *Recent Case Law*

Case law refers to the interpretations of the law which have entered into the decisions handed down by the courts in settling disputes. Case law thus validates or limits air pollution control enactments, and constitutes a third component of the authority of air pollution control law. Case law in the United States results primarily from decisions handed down in a federal court, or appellate or higher court in any state. Since Municipal and Superior court decisions are not generally reported to the bound case records, their precedence is generally limited to the jurisdictions in which they apply. Case decisions are extremely important to the control effort since they may settle questions of law for the first time. Cases which are appealed to the higher courts have a tendency to either strengthen, confirm, or weaken specific air pollution control provisions.

Generally speaking, most of the air pollution cases which are appealed to the higher courts test the constitutionality of the control act by means of the due process clause of the Fourteenth Amendment, a few by the equal protection clause.These tests of law determine how far air pollution control laws may go without violating due process of law. The results of most of the recent air pollution cases handled in the courts demonstrate that control law can be as strict as is reasonably necessary. Case law has, consequently, provided a strong and adequate authority to control by legal means modern air pollution problems.

1. Precedent-Making Decisions

A few of the important precedent-making decisions which contribute to the power of the people to enact air pollution control laws may be summarized from Kennedy[7] as follows:

1. The power to prohibit the emission of dense smoke in cities or populous neighborhoods is inherent in the police power of the state. Smoke can be declared a nuisance and be subject to restraint . . . the harshness of such legislation, or its effect upon business interests, short of merely arbitrary enactment, is not a valid constitutional objection.[h]

2. The validity of statutes prohibiting visible or invisible pollutants under state authority need not be based on the concept of nuisance.[i]

3. Ordinances based on a definite scientific standard for the density of smoke, such as the Ringelmann Scale (see Chapter 10), are approved if such standards or equivalent standards are specified in the law.[8] The point at which emissions of air contaminants are prohibited or are permissible is a matter of legislative discretion, which the courts will validate.[e]

4. Statutes or ordinances are not invalid and unreasonable merely because there is no known control device or technique to permit compliance.[j] Such laws, however, cannot require compliance that is impossible to attain. They may not prohibit entirely air pollution

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[d] *A Review and Appraisal of Air Pollution Legislation in the United States*, by Samuel M. Rogers, June 4, 1957, for the golden jubilee meeting of the A.P.C.D., St. Louis, Mo. (per Reference No. 3).

[e] *Board of Health of Weehawken Township v. New York Central Railroad*, 10 N. J. at 306, 90 Atl. (2d) at 735.

[f] Kennedy, Harold W. in reference 7, "Validity Not Based on Nuisance", cases cited, p. 381.

[g] However, the Congress of the United States has very definite, though indirect, powers to regulate pollution of the national air space, if warranted, in the same way that it regulates pollution of navigable streams under the commerce clause of the Constitution.

[h] *Northwestern Laundry v. Des Moines*, 239 U. S. 486, 36 Sup. Ct. 206, 60 L.Ed. 396 (1916).

[i] *Board of Health of Weehawken Township v. New York Central Railroad*, 10 N. J., at 306, 90 Atl. (2d) at 735.

[j] *Moses v. U. S.*, 16 App. D. C. 428.

or any class of air pollution, but must establish standards of reduction consistent with scientific possibility.[k]

5. A law or ordinance prohibiting one type of contaminant in a community is not invalid because there is not a law or ordinance regulating another type of contaminant.[l]

6. Laws are not valid in regard to any injury to the public which is trivial, fastidious, or offensive merely to the esthetic senses.[m] On the other hand, it is not necessary to show impairment to health in order to establish the emission of smoke and fumes as a nuisance and to permit its abatement by law. Discomfort, inconvenience, and annoyance to the public are sufficient.[i][n]

7. Several sources of air pollution may be found liable in contributing jointly to a nuisance.[o]

Other case laws arising from the Los Angeles problem will be discussed in relation to the enactment of the California Air Pollution Control Act.

II ENACTING AIR POLLUTION CONTROL LAW

An air pollution control act is a body of law consisting of civil procedures, specific laws, legislative determinations and findings, prohibitions, and rules and regulations intended to implement and provide for the administration of air pollution control programs in recognized pollution zones. Air pollution law, fundamentally, is the responsibility of the state legislature either through legislation which directly affects the entire state, or through legislation which delegates powers to local governing bodies such as boards of supervisors and city councils.

A. Public versus Private Interests

The creation of air pollution legislation results from the resolution of conflicts between public and private interests. On one side citizens demand clean air; on the other, private interests wish to protect their rights and interests without public interference. The demand for clean air usually begins with the expression of public opinion through communication media, taxpayer groups, associations, citizens' committees, government agencies and officials. The demand for clean air may develop into a political issue, and legislative committees or other political bodies may form for the purpose of drafting proposals for debate and final enactment.

On the negative side are those groups which either oppose control in its entirety, or raise objections to specific provisions in the control bill. These may not only include industrial and trade groups, but citizens' committees, and taxpayer groups. Some of the opposition may express a sincere interest in the effects of control on the economy, while others may reflect the desire to protect private interests, or positions which rationalize a political belief. Some of the sincere opposition may arise, also, from civic-minded groups who believe that control can be achieved best through voluntary action without resorting to government control. Because effective legislation must take into account the objections made, some of them are included here:

1. Some believe that smog is merely a product of higher civilization and must be accepted and coped with accordingly; that there is nothing essentially harmful about air pollution which can be demonstrated; and that a smoking stack, a symbol of prosperity, is of benefit to the community.
2. Some believe that the control of air pollution costs great sums of money, both immediately and on a continuing basis, and object that the costs of control are likely to be passed on to the consumer in the form of higher prices.
3. Some believe control has disproportionate effects on competition in that the area with air pollution control is unable to compete with an area without air pollution control.
4. Some believe that governmental interference should be avoided on its own merits.
5. Some fear that changes in traditional modes of operation, necessitated by control measures, threaten the existence of certain industries.
6. Others feel that industry should pay for and solve its own air pollution problems. This is a taxpayer's position, as well as industry's, and is frequently expressed as voluntary self-control.
7. Still others complain of specific legislation intended to control specific types of air contaminants, since the relative effects of various contaminants in the local atmosphere may not as yet be ascertained. This faction believes that control should await research findings. Others oppose specific provisions in the proposed laws such as the permit system.
8. In the case of Southern California, many of the individual cities initially objected to county-wide control on the basis of how such a control agency might be financed, and the possible application of the control authority to municipally owned equipment.

These conflicts, of course, can only be resolved by the orderly process of law. If the law-making body determines that the atmosphere is polluted to an extent that the peace, health, safety and welfare of the people of the state are disturbed, then the right to control air pollution by means of legislation assumes precedence over interests which seek to prevent such control.

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[k] *Department of Health of the City of New York v. Phillip and William Ebling Brewing Co.*, 38 Misc. 537, 78 N. Y. S. 13. (Mun. Ct. City of N. Y., 1902).

[l] *Ballentine v. Nester*, 350 Mo. at 69, 164 S. W. (2d) at 381.

[m] *Tuebner v. California Street R. R.* 66 Cal. 171, 4P, 1162, 1164 (1884).

[n] *Judson v. Los Angeles Suburban Gas Co.*, 157 Cal. 168, 106 Pac. 581, 26 L. R. A. (N.S.) 183 (1910).

[o] *Ingram v. City of Gridley*, 100 Cal. App. (2d) 815, 823-824, 224 Pac. (2d) 798, 803 (1950).

The outcome of the struggle between proponents of strong measures and proponents of token or voluntary measures is highly important inasmuch as the entire capability of controlling air pollution is being determined. The final control bill may compromise interests, or, where compromise is rejected, conflicts may be resolved by wise revision of control proposals. The object of control legislation is to provide powers which make the control of air pollution clear and certain while protecting the equities and constitutional rights of individuals. Where an air pollution problem is severe, involving unknowns, legislation must make ultimate solutions possible. Also, while the law must be clear and certain in its regulatory provisions, it must also be broad and flexible enough to permit the control agency to cope routinely with problems which daily arise. The scope and stringency of the law, also, should not be in excess of that required to accomplish efficient control, nor should it be so weak as to render control ineffective.

B. *Construction of the Air Pollution Law*

The approaches to establishing air pollution control law and the creation of control authorities vary from state to state. Regulatory ordinances may be individually incorporated into existing Health, Safety, or Engineering Codes, or separate chapters or sections may be adopted respecting the establishment of an air pollution control authority together with a related body of administrative laws.

The primary control jurisdiction always rests with the state. But the state may delegate wholly, or in part, its police powers to communities (counties and cities). Usually the state determines and defines the authority for local control before it delegates the rule-making power. In each community, then, two distinct bodies of law may be involved: (1) the state law, and (2) the rules and regulations, or the ordinances of the local control authority. Regardless of how such laws are constituted, the control law will require the following declarations, powers, and provisions:

1. Findings as to the Existence of Air Pollution

The findings as to the existence of air pollution problems in a community or portions of a state are based on public hearings and expert testimony. The law declares its findings, usually in the form of a preamble, stating that air pollution is detrimental to the health, welfare, comfort, and well-being of the state, thereby establishing the fact that air pollution is in and of itself an absolute nuisance. The right of people to obtain relief from polluted air under the police power of the state is affirmed. Specific regulations and prohibitions intended to control contaminant emissions are then justified.

2. Creation of the Control Authority

At the same time, the law states, either specifically or generally, the existence of pollution zones and establishes the specific authority or the nature of that authority which will encompass and regulate recognized pollution zones. The law may provide for the creation, organization, staffing, budgeting, and administration of an air pollution control authority, agency, district, board or commission. State practices, in this regard, differ substantially in the placement of the control authority.

Of the 9,500 communities in the United States experiencing local air pollution problems, 2,050 have adopted some kind of legislation aimed at controlling air pollution.p) A large part of such legislation is designed to attack specific air pollution problems on the city level, and undoubtedly much of such legislation is based primarily on common law or statutory nuisances. The enforcement of such laws is usually conducted by the police, health, fire, engineering and safety departments or other subdivisions of municipal bureaus. Only a small minority of such communities have enacted comprehensive independent control authorities.

With the advent of air pollution over large municipalities or extended metropolitan areas, a single and unified authority armed with air pollution control laws became necessary. The level of authority (city, county, state, etc.) necessary to control air pollution is determined primarily by the character of the pollution zone. If the boundaries of a city contain the pollution zone, then a municipal agency, or a bureau or division of a municipal agency may suffice, if that agency and the laws it promulgates and enforces are authorized by the police power of the state. If the pollution zone is larger than the municipal area, or constitutes several political organizations, then the control effort must be conducted at a higher political level — at the county or state level, for example. There are presently in the United States five principal types of air pollution control authorities, aside from those which are vested in the branches or divisions of agencies not devoted exclusively to air pollution control.

a. Municipal Departments or Bureaus of Air Pollution Control. A good example is the City of New York which, in 1952, instituted a Department of Air Pollution Control. In this city a board of air pollution control was established with the power to promulgate, adopt and enforce rules aimed at controlling air pollution within the boundaries of New York City.

b. State Air Pollution Authority. This authority is frequently established by smaller states. Dela-

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p) 8 Baylor Law Review, 249, 1956, citing report of Arthur C. Stern.

ware and Oregon have created organizations responsible for promulgating and enforcing rules and regulations on a state-wide basis. The Oregon Air Pollution Control Authority encourages cities to maintain local control programs, and provides them with technical assistance.

c. State Air Pollution Enabling Authority. California, in 1947, adopted the first state-wide air pollution control statute, but in doing so left the actual enforcement to local air pollution control districts on the county level. This type of act is called an enabling act. Following its adoption in 1947, Los Angeles County immediately set up a control district and was later followed by San Bernardino, Riverside, Orange and San Diego Counties. Under a special provision of the Air Pollution Control Act (The Health and Safety Code) a nine-county air pollution control district was formed in the San Francisco Bay area. This consists of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

d. Interstate Compacts. Establishment of interstate compacts can arise when it becomes necessary to control a pollution zone comprising several contiguous metropolitan areas in neighboring states. An air pollution problem exists in a well populated region which includes Staten Island, Manhattan, and New Jersey. To control this regional problem an interstate commission was authorized by the legislatures of New Jersey and New York to agree upon an adequate control program for the areas, enforced by agencies within the respective states. The power to enter in such compact is limited by consent of Congress which can, however, be given after such compact has been established.[q] Federal approval came in 1956 when Congress authorized this commission to carry out the study.

e. International Compacts or Treaty. International air pollution problems are encountered in the Detroit-Windsor and in the Port Huron-Sarnia areas along the borders of the State of Michigan and Canada. Most of this air pollution results from heavy marine traffic, but some originates from stacks of industrial plants on both sides of the border. This international problem is under study by the International Joint Commission to determine whether it can be controlled by regulations resulting from a treaty between the United States and Canada.[r]

3. Source Regulations and Prohibition

If the primary authority is the state law, the state may reserve the right to create and pass on all control standards and regulatory statutes, or it may delegate that power to local governments or control authorities. When it is necessary to establish uniform standards throughout the state, the law includes such standards. But where controls are required for local pollution problems only, the state delegates the rule-making authority to the local control authority.

The statutes, ordinances, or rules and regulations which are finally adopted for the purpose of controlling the sources of air pollution, fall into the following categories:

a. Public Nuisance

A version of the common law nuisance is included in the law which directly makes illegal any quantity of air contaminants which has a detrimental effect on the health, comfort and property of any considerable number of persons. Because the nuisance does not incorporate specific standards, it must be established on its own merits in each case.

b. Maximum Permissible Emission Standards

These are a class of regulations which prohibit quantities of contaminants from a specific source in excess of standards specified. The standard may be stated in terms of (1) maximum opacity, shade, or optical density of the effluent (Ringelmann Standard), together with a time limit, (2) a maximum dust or particulate, or contaminant gas loading for effluent emissions either in terms of grains per unit volume of stack gas, gas volume, or weight of contaminant lost per weight of materials processed in equipment.

c. Regulation of Use or Design of Equipment

This type of rule regulates the equipment or process constituting the source of pollution by such means as will certainly accomplish the desired reductions in the emission of air contaminants. This may be done by (1) banning the use of a certain type or category of equipment or activity, (2) establishing design standards for usable equipment, (3) establishing operational standards, and (4) requiring the use of specific types of control equipment or control techniques.

It is assumed that the adoption of these equipment regulations will result in reducing pollution emissions so that such equipment or activity does not violate any of the other prohibitions contained in the legal authority, such as the public nuisance or the maximum permissible emissions, as well as reducing emissions to desirable levels.

d. Regulation of Fuels or Fuel Composition

These regulate the use or composition of fuels themselves and may require, for example, the washing, coking, briquetting of coal, etc., specification of smokeless grades of fuels, the reduction of the sulfur content of fuel oils, reduction of the olefinic hydrocarbons in gasoline, regulation of liquid vapor pressures, etc. In such cases the regulation usually affects the producer, rather than the consumer, of these fuels.

A comprehensive air pollution law generally incorporates all of these laws according to the need of the control program being conducted. The actual criteria on which these standards are based are considered in Chapter 4 and elsewhere in this manual.

4. Registration of Pollution Sources (Permit and Licensing Systems)

Most air pollution control authorities provide for a system of source registration which may or may not include a permit or licensing system. Permit or licensing systems are one of the most effective types of source control regulation in that all sources of air pollution are systematically and thoroughly reviewed for compliance and air pollution potentials. The object of these systems is to obtain permanent and continuous compliance and to check the growth of the sources of air pollution. Equipment capable of violating any of the provisions of the control law, including the public nuisance, is not permitted to operate in the pollution zone. Some control authorities, however, may omit this strict feature, but provide for a system of registration from which air pollution potentials only are determined. (See Chapter 4.)

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[q] Kennedy, H. W., reference 8, p. 389, which quotes Article I, Section 10, clause 3, as follows: "No state shall, without the consent of Congress . . . enter into any agreement or compact with another state . . ." The courts have held that this consent may be given by Congress after, as well as before, the agreement between the States is made. *State v. Joslin*, 116 Kan. 615, 227 p. 543.

[r] Cooper, W. S., reference 3, p. 424.

5. Enforcement Powers

In order to enforce the law, the air pollution control officer and his deputies, i.e., air pollution inspectors and other enforcement personnel, must possess peace officer powers for the purpose of entering industrial and commercial establishments and halting vehicles on the public highway. The air pollution control law also classifies the types of violations involved, such as misdemeanors, felonies, etc., and enables the agency to take civil or criminal action against violators. Air pollution violations, however, are almost always misdemeanors. Furthermore, the law may provide for offenses resulting from interference with the accomplishment of inspectors' duties, non-cooperation, circumvention, false documentation, refusal to submit information, and operation of equipment without permits.

6. Hearing or Appeals Procedures

Most laws of a control or regulatory nature conform to the principle of the separation of powers, i.e., distinguish between legislative, judicial, executive or, in this case, enforcement, functions to provide checks and balances and to avoid arbitrary conduct. Even though an air pollution control authority may be provided for in the law, the three functions are created independently: the law-making body in a board or commission, the enforcement component in the control agency itself, and the judicial in a specially constituted appeal or hearing board, and the courts themselves. Where a permit system is used, a hearing board is mandatory, but procedure for appeal must also be provided for in those cases where immediate compliance may result in hardship or cessation of a lawful business. In such cases the air pollution control law provides for a variance procedure. Such a board is generally independent of the control agency proper, although it is sometimes constituted in the rule-making body.

7. Emergency Provisions

A comprehensive air pollution law provides the control authority with emergency powers in the case where an air pollution disaster is possible or imminent. Such powers enable the control agency to shut down all air polluting activity. conduct air monitoring to detect worsening conditions, and notify the sources of air pollution and the community of alert levels.

III ENACTMENT OF AIR POLLUTION CONTROL LAW IN CALIFORNIA

Although the exact year when smog was first recognized as a problem in Los Angeles is not known, the public appears to have first demanded relief from air pollution immediately after World War II. Newspapers, in particular, began to expose the problem in the public interest. During the summer of 1943, public opinion was vehemently expressed through a vigorous editorial campaign conducted by the *Los Angeles Times*. As a consequence, air pollution control groups were set up under health department jurisdictions — first by the city of Los Angeles, and then by the county of Los Angeles in the unincorporated areas. Additional smoke control ordinances were also passed by many of the 45 cities then in the county. However, these control efforts failed due to the multiplicity and inadequacy of the control jurisdictions. It was soon apparent that adequate control action could only be taken by a single control authority with jurisdiction over the entire pollution zone — the incorporated and unincorporated areas of Los Angeles County.

Public protest led to action on various levels, principally citizens' committees, associations and leagues, and government. The first Citizens' Smog Committee, headed by William Jeffers, a retired railroad president and wartime rubber "czar," was formed. A Legal Advisory Committee, consisting of noted lawyers and judges, followed. The League of California Cities, the Board of Supervisors, and the County Counsel's office of Los Angeles County all cooperated in promoting and developing air pollution control measures. As community action broadened, scientists and experts studied the various aspects of the Los Angeles problem in order that control legislation could be advanced from valid technical assumptions.

A. The California Control Act

After presentation of Assembly Bill No. 1, which crystallized the final control proposals, the 1947 session of the California Legislature voted to add Chapter 2, "Air Pollution Control District", to Division 20 of the Health and Safety Code, relating to the control and suppression of air pollution. Thus, the first state-wide air pollution control statute was enacted.

The California Act is an enabling type of legislation which provides the legal basis for the establishment of air pollution control districts on a local option basis by the counties of California. The law is organized into seven articles of the State Health and Safety Code. These are:

ARTICLE 1 — Creation and Functioning of Districts

In essence this article states the conditions and procedures by which *air pollution control districts* can be established by the counties of California.

In the preamble of this article, the legislature determines that air pollution problems exist in certain portions of the state by declaring that . . . (Sec. 24198)

> . . . the people of the State of California have a primary interest in atmospheric purity and freedom of the air from any air contaminants and that there is pollution of the atmosphere in many portions of the State which is detrimental to the public health, safety and welfare of the people of the State.

The legislature defines some of these air contaminants to include "smoke, charred paper, dust, soot, grime, carbon, noxious acids, fumes, gases, odors, particulate matter, and other air contaminants," (Sec. 24208), and goes on to say that it is necessary to provide for air pollution control districts in those portions of the state where regulations are necessary and feasible to reduce air contaminants to safeguard life, health and property and the public welfare and to make possible the comfortable enjoyments of life and property (Sec. 24199). The legislature then delegates to the board of supervisors of each county the power to determine that the air within such county is so polluted with air contaminants as to be injurious to health or an obstruction to the free use of property of a considerable number of persons, or which interferes with the comfortable enjoyment of life or property (24203, 24204). Once the board of supervisors of any county has determined that such a condition exists, an air pollution control district coterminous with that county is created with all of the authority of the State Act (24205).

ARTICLE 2 — Officers

This article states that the supervisors of each county are the members of the air pollution control board of the air pollution control district of that county, and that the air pollution control board shall appoint an air pollution control officer, and a hearing board consisting of three members. Two members of the board shall have been admitted to the practice of law in the State of California, and one member shall be either a mechanical or chemical engineer. In addition, this law provides that the air pollution control officer, his assistants, deputies, etc., are entitled to civil service provisions and benefits.

ARTICLE 3 — Prohibitions

This article deals primarily with standards prohibiting the emissions of contaminants, provided that a control district has been activated. These prohibitions are vital to the enforcement operation of the districts and are utilized in a great many enforcement actions. These are principally Section 24242, excessive emissions of visible contaminants, and Section 24243, public nuisances. In addition, the law also establishes, in Section 24246, the right of entry into any industrial or commercial establishment during reasonable hours, and the right to halt all vehicles which do not run on rails.

Section 24242 reads as follows:

> A person shall not discharge into the atmosphere from any single source of emission whatsoever any air contaminant for a period or periods aggregating more than three minutes in any one hour which is: (a) as dark or darker in shade as that designated as No. 2 on the Ringelmann Chart, as published by the United States Bureau of Mines, or (b) of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subsection (a) of this section.

There are certain exceptions to the provisions of Section 24242 set forth in Section 24245 and 24251 of the Health and Safety Code. In general, these exceptions apply to agricultural operations, the abatement of a fire hazard, and the instruction of public employees in fire fighting methods.

Section 24243 states the public nuisance as follows:

> A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.

The provisions of Section 24243 do not apply to odors emanating from agricultural operations and the growing of crops or the raising of fowls and animals.

The law provides that any person who violates these sections is guilty of a misdemeanor, and enables an air pollution control district to enjoin in a civil action any violators of these provisions.

Section 24246 relates to refusal of entry, or failure to halt vehicles as follows:

> The Air Pollution Control Officer, during reasonable hours, for the purpose of enforcing or administering this chapter, or any provisions of the Vehicle Code relating to the emission or control of air contaminants, or of any order, regulation or rule prescribed pursuant thereto, may enter every building, premises, or other place, except a building designed for and used exclusively as a private residence and may stop, detain, and inspect any vehicle, designed for and used on a public highway but which does not run on rails. Every person is guilty of a misdemeanor who in any way denies, obstructs, or hampers such entrance, or such stopping, detaining, or inspection of such vehicle, or who refuses to stop such a vehicle upon the lawful order of the Air Pollution Control Officer.

Article 4 — Rules and Regulations

Perhaps the most important feature of the California State Health and Safety Code is Article 4 which provides the air pollution control district with the power and procedures for enacting rules and regulations as may be required to control any air pollution control problem and to accomplish the purposes of this law. The California Health and Safety Code thus enables the control districts to be flexible in handling problems of a local nature and provides a potential whereby future or unanticipated air pollution problems can be legally regulated. The specific rules and regulations enacted by the air pollution control board of the district (the board of supervisors) provide the specific battery of administrative law required to control local air pollution problems in California.

New rules and regulations necessary for the proper administration of Chapter 2, Division 20, of the Health and Safety Code and those necessary to reduce the amount of air contaminants released within the control district can only be enacted after first holding a public hearing. Ten days notice is required before the hearing is held.

The article also provides that the air pollution board may require permits for the building, erection, alteration, or operation of any equipment capable of emitting air contaminants and provides that if an air pollution control district adopts a permit system, any person who constructs, alters, or uses such equipment without a permit, is guilty of a misdemeanor. Detailed exceptions, however, are made in Section 24265. In this section, equipment of a minor nature, or any for which the permit process is inapplicable, or impractical to enforce, is exempted.

To make the permit system more workable, the law provides that the air pollution control officer may require from either the applicant for a permit, or the holder of a permit, information, analysis, plans, and specifications which disclose the nature, extent or quantity of air contaminants released by the equipment; and provides that if a person fails to supply such information he is guilty of a misdemeanor. The air pollution control officer may also suspend his permit.

Article 5 — Variances

In essence, this article provides for the granting of variances from the requirements of either the state law or the rules and regulations of the air pollution control district. Such variances can only be granted after a public hearing before the hearing board. The hearing board is granted wide discretion in the weighing of equities which may arise in each case, although limited by conditions set forth in Section 24296 of the Health and Safety Code. The hearing board, for example, cannot grant a variance for longer than one year. A variance may be continued from year to year, however, without a further hearing, provided the air pollution control officer agrees to the extension of the variance.

Article 6 — Procedure

This article provides a procedure whereby any person deeming himself aggrieved by a decision of the hearing board may file a proceeding in the Superior Court to determine the reasonableness and legality of the action of the hearing board, and entitles the person to a trial *de novo* and an independent determination by the court on all the issues.

Article 7 — Unified Air Pollution Control Districts

This article provides a procedure by which two or more counties having activated air pollution control districts may merge the several districts into one.

B. *Enactment of Rules and Regulations in Los Angeles County*

Under authority of the Health and Safety Code, the Board of Supervisors of Los Angeles County held hearings in the fall of 1947 and found that the need existed for the establishment of an Air Pollution Control District. The Los Angeles County Air Pollution Control District was activated on October 14, 1947, and on December 30, 1947, the first Rules and Regulations guiding the conduct of the Los Angeles County Air Pollution Control District were enacted. Additional rules and regulations were subsequently added as the need arose.

The Rules of the Los Angeles County Air Pollution Control District are divided into seven regulations, as follows: I "General Provisions," II "Permits," III "Fees," IV "Prohibitions," V "Procedure Before the Hearing Board," VI "Orchard Heaters," VII "Emergencies."

The Rules and Regulations are quite extensive and should be consulted for detailed information. This chapter will attempt to summarize these Rules to indicate the scope of the authority of the Los Angeles County Air Pollution Control District, and a few salient characteristics of these Rules which have either been contested and validated in the courts, or form the basis of an active control program.

Regulation I — General Provisions

These define important terms employed in the Rules such as "Los Angeles Basin," the various contaminants and equipment, as well as describing standard conditions in making calculations for analyses and source tests.

Regulation II — Permits

The permit system of the Los Angeles County Air Pollution Control District is one of the most important features of the air pollution control program. In general, it requires owners, operators, or lessees to apply for permits to construct *and* operate any equipment capable of emitting air contaminants. If the applicant's plans, specifications, and actual field tests show that the equipment can operate within the limits allowed by law, a permit is granted. If the equipment is capable of emitting contaminants which create a public nuisance, or violate any of the sections of the State Health and Safety Code or the Rules and Regulations of the Air Pollution Control District, then permission to construct such equipment or permit to operate equipment already constructed is denied.

The effectiveness of the permit system as far as the control program is concerned consists, in essence, of eliminating from use equipment which emits excessive air contaminants or of requiring the reduction of emissions from equipment to within allowable limits by modifying design or process, or constructing adequate control equipment. The construction and operation of control equipment also must be authorized by permit. Thus, the permit system is a positive means of controlling air pollution.

Regulation III — Fees

Authorizes and states conditions under which fees may be paid by applicants for permits to construct and operate equipment, according to a specified fee schedule.

Regulation IV — Prohibitions

The rules contained in this regulation are intended to prohibit and regulate the emission of certain air contaminants, or certain types of equipment, and are of primary concern to field control operations. As these rules are applied to engineering problems, and touch upon many sciences, extraordinary care is required to frame them so that they fulfill their function. Although these rules have been tested frequently in the courts, no substantive rule of the Los Angeles County Air Pollution Control District yet has been held to be unconstitutional. Over a period of years these prohibitions have been found to be practical and intelligible to those who must observe them, as well as to those who must enforce them.[13] The prohibition rules are estimated to have resulted in controls which have prohibited the emission of 3640 tons of pollution into the air each day[13], as shown in Table III-1.

The basic operational rules in this series are Rule 50, *Ringelmann Chart*, which is an exact reiteration of Section 24242, quoted previously, and Rule 51, *Public Nuisance*, which is an exact reiteration of Section 24243. Violations of these rules can be ascertained through field investigation. However, the rules on combustion contaminants, dust and fumes, etc., require an analysis of the emission in order to determine compliance. A summary of these rules can be noted in Table III-2.

a. Rule 50 — The Ringelmann Chart

The Rule which is basic to the enforcement operation is Rule 50, which provides standards for the reading of densities and opacities of *visible* emissions in determining violation of, or compliance with, the law in the field.

The importance of this rule, of course, lies in the fact that it presents an effective and practical standard by which excessive emissions can rapidly be determined. Without this Rule, the enforcement operation would be severely handicapped. This Rule, however, has been subject to several searching court tests concerning (1) the validity of using the Ringelmann Chart as a standard; and (2) the validity of reading smoke without physical reference to the Ringelmann Chart in the field, and other technical matters relating to the reading of smoke which are discussed in detail in Chapter 10. (See also Figure X-1.)

In the validation of Section 24242 (and hence, Rule 50), the Appellate Division of the California Supreme Court in the case of *People v. International Steel Corporation* [s] determined that it was permissible for a statute to refer to and adopt in the description of a prohibited act an official publication of a United States board or bureau established by law, such as the United States Bureau of Mines, publisher of the Ringelmann Chart. The court, in reviewing the Ringelmann Chart itself, came to the conclusion that the statute adopted was not lacking in certainty, and that the line in the standard between permission and prohibition is a valid matter of legislative discretion.

In a series of cases which were consolidated on appeal, *People v. Plywood Manufacturing Company, People v. Shell Oil Company, People v. Union Oil Company*, and *People v. Southern California Edison Company,*[t] the Appellate Division of the Superior Court, in a lengthy and detailed opinion, stated that (1) both subsections of Section 24242 were constitutional and enforceable; and (2) a witness can testify to the opacity or density of visible emissions without using a Ringelmann Chart at the scene, provided that he has been properly trained. "We see no reason to depart from this conclusion that a witness may testify although he did not have a Ringelmann Chart actually in the field with him at the time that he made his observation. One does not have to have a color chart in his hands to recognize a red flower, a blue sky, or a black bird. The question is one of credibility not competency. Nor, do we assume that we see any difficulty arising from the fact that a plume of smoke, for example, may appear less dark than #2 Ringelmann from one position, but darker than #2 Ringelmann from another point. If the contaminant has the substance that fairly viewed from any position and gives a shade of dark or darker than #2 Ringelmann, it is condemned no matter how light the color may look to someone situated at another vantage point." In general, other rulings on Section 24242 in these and other

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[s] 102 Cal. App. (2d) (Supp.) 935, 938-939, 226 Pac. (2d) 587, 590 (1951)

[t] *People v. Plywood Mfr's. of Calif., Shell Oil Co., Union Oil Co.,* and *Southern California Edison Co.,* Cal. Juris. 291 P2d 578 137 CA2 SUP. 859.

TABLE III - 1

EFFECT OF LOS ANGELES COUNTY A.P.C.D. RULES ON EMISSIONS FROM STATIONARY SOURCES

MAY 1961

EMISSION SOURCE	CONTAMINANTS PREVENTED FROM ENTERING L.A. ATMOSPHERE IN TONS PER DAY																														Totals of Contaminants Reduced in Source Categories
	Hydrocarbons & Other Organic Gases						Olefins, Unsaturates	Sulfur Dioxide			Oxides of Nitrogen		Carbon Monoxide		Smoke Opaque Plume			Particulate Matter		Combustion Contaminants			Dusts Fumes		Odors						
CATEGORY / APCD RULE No.	56	57,58 56.1	59	61	62	OTHER	63	53a	57,58 56.1	62	57,58 56.1	62	57,58 62.1	OTHER	50	57,58 56.1	62	51	52	53b	57,58 56.1	62	51	54	51	56	57,58 56.1	59	61	62	
INCINERATION & REFUSE BURNING																															
Municipal incinerators																															
Industrial "																															
Commercial "		125							20		20		170		x	x		x		x	75				x		x				410
Residential "																															
Open fires																															
FUEL OIL BURNING																															
Power plants, refineries & others					7			113		460		150			x		x			x		40									770
PETROLEUM REFINING																															
Catalytic cracking						18	(9a)							620	x									5							
Storage	350																								x	x					
Separators & sewers			105												x										x			x			1850
Flares						x																									
Blowdown & relief valve systems						125																			x						
Refinery gas burning								512		25					x		x														
Others						90																			x				x		
PETROLEUM MARKETING																															
Bulk Storage (Ref. storage not included)	5						x																			x					
Bulk loading				50		x	(1a)																						x		55
Service station storage						x																									
Service station loading																															
PETROLEUM PRODUCTION																															
Storage																															
Other (gas blowoff, etc.)						225																									225
METALS																															
Furnaces for magnesium																															
" " aluminum																															
" " brass															x									75	x						
" " bronze																															
" " lead																															
Grey iron melting cupolas														x	x									7							95
Electric steel melting furnaces															x									7							
Open hearth " " "															x		x							6							
Galvanizing kettles															x									x							
Other															x									x							
CHEMICAL																															
Sulfur and sulfuric acid															x			x	x						x						
Phosphates and phosphoric acid								24																							
Fertilizer						20												x	x					20	x						65
Other	1		x	x											x													x			
MINERAL																															
Asphalt batching						4									x		x						x	25							
Asphalt roofing saturators						(0.08)									x								x	2							135
Insulation															x								x	2							
Glass & frit furnaces															x									1							
Concrete batching															x								x	1							
Other															x								x	100							
ORGANIC SOLVENT USE																															
Surface Coating						x									x			x													
Degreasing																															
Dry cleaning						1																									
Rotogravuring																															20
Paint bake ovens						19									x					x					x						
Varnish cooking						x									x					x					x						
Other															x					x					x						
MISCELLANEOUS																															
Rendering (Inedible)															x			x							x					x	
Coffee roasting															x			x							x						
Meat smokehouses															x			x							x						15
Feed & grain															x			x						2							
Wood processing															x			x						2							
Other															x			x						11							
TOTALS OF CONTAMINANTS REDUCED BY A.P.C.D. RULE	356	125	105	50	7	502	(10a)	649	20	485	20	150	170	620	x	x	x	x	x	x	75	40	x	266	x	x	x	x	x	x	**3640**

a • This figure is not included as a reduction in total emissions but a change of type of hydrocarbons emitted to the atmosphere (about 159 tons/day of olefins are converted to other hydrocarbon compounds in the automobile engine).

x • Contaminant reduction not capable of being measured quantitatively.

Source: *Reference* 13

TABLE III-2
TYPES OF PROHIBITIONS
RULES AND STATE CODE SECTIONS PRINCIPALLY INVOLVED IN ENFORCEMENT OPERATIONS

EXCESSIVE EMISSIONS		UNAUTHORIZED CONSTRUCTION OR OPERATION OF A/P EQUIPMENT	EQUIPMENT REGULATION	EMERGENCIES	BANS	NON-COOPERATION AND CIRCUMVENTION
Visible	Invisible					
Sec. 24243. Public Nuisance. **Sec. 24242** Contaminants excess of #2 Ringelmann or 40% opacity for more than three minutes in any one hour. **Sec. 27153.** Vehicle Code. Any unduly excessive emissions for vehicles.	**Sec. 24243.** Public Nuisance. **Rule 52.** Particulate matter excess of .4 gr. cu. ft. **Rule 53a.** Sulfur Compounds, .2% by volume as SO_2. **Rule 53b.** Combustion Contaminants, .3 gr. cu. ft. gas, calculated to 12% CO_2. **Rule 54.** Dusts exceeding amts. for each process weight on graduated scale.	**Sec. 24278.** Operation or erection under suspended or revoked permit. **Sec. 24279.** Operation or erection without permit or authority to construct. **Sec. 24280.** Operation or erection contrary to provisions of permit.	**Rule 56** requires vapor loss control devices for storage tanks under specified conditions. **Rule 59** requires vapor loss control devices for oil-water separators under specified conditions. **Rule 61** requires vapor loss control devices for gasoline loading facilities under specified conditions. **Rule 64** requires incineration of malodors from animal rendering industries.	**Rule 157** burning of rubbish in open fire or s/c incinerator during first alert. **Rules 158 and 159.** Acting contrary to the instructions of the air pollution control officer.	**Rule 57** open fires. **Rule 58** s/c incinerators. **Rule 62** bans the use of high sulfur fuels seven months each calendar year. **Rule 63** bans the use of gasoline with high olefinic content.	**Rule 60.** Circumvention, reducing, concealing or diluting emissions which would otherwise violate. **Sec. 24246.** Refusal of entry or refusal to halt vehicles.

decisions have upheld the practical use of the Ringelmann Chart in the field.

b. Rule 51 — Nuisance

The wording of this rule is identical to that of Section 24243, quoted previously. According to this rule, whatever tends to endanger life or property or whatever affects the health of the community is generally a public nuisance. The nuisance, however, must affect the community at large and not merely one or a few persons. It is sufficient to establish a crime from a nuisance if it contributes seriously to the discomfort of an area.

An important feature of the nuisance is that it is not a crime which requires a specific intent. The *intent* of a person to maintain a nuisance which is dangerous or offensive to the public is entirely immaterial.

Moreover, nuisances cannot be justified by the fact that the public is benefited as well as injured by the act alleged to be a nuisance, as, for example, that the business is useful or necessary or that it contributes to the wealth and prosperity of the community. Neither does mere lapse of time give a right to maintain a nuisance nor the fact that it was first established away from the population, and that the population had later approached.

The public health, the welfare and safety of the community, are matters of paramount importance, to which all pursuits, occupations, and employments of individuals inconsistent with their preservation must yield.[u]

There is a conflict of authority, however, on this point and it would appear that the law does balance equities with respect to the particular surroundings, the character of the business and its particular location. In one case, it was said, "People who live in great cities that are sustained by manufacturing enterprises must necessarily be subject to many annoyances and positive discomforts by reason of noise, dirt, smoke and odors more or less disagreeably produced by and resulting from the business that supports the city. They can only be relieved from them by going into the open country."[v]

The enforcement procedure for the public nuisance statute cannot be standardized and must, therefore, be conducted according to the merits of each case, due to the uncertainty of this law. A proceeding under the nuisance section of the Health and Safety Code of California must establish the elements of the crime and such additional testimony as is necessary to prove that it caused injury, detriment, nuisance or annoyance to any considerable number of persons or to the public. Also, proof that it endangered the comfort, repose, health and safety of any such persons or the public. The conduct of handling a Public Nuisance inspection is described in detail in Chapters 12 and 13.

c. Rule 52 — Particulate Matter

This rule establishes the maximum allowable limits for the discharge of particulate matter. It limits the discharge of this contaminant from any source to a maximum concentration of .4 grains/cu. ft. of gas.

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[u] *Com. v. Upton*, 6 Gray (Mass.) 473.
People v. Detroit White Lead Works, 82 Mich. 471.

[v] *Com. v. Miller*, 139 pa. 77, 214 A. 138, 23 Am. St. Rep. 170.

This rule, however, does not apply when the particulate matter is a combustion contaminant.[w]

d. Rule 53 — Specific Contaminants

This rule establishes the maximum allowable limits for the discharge of sulfur compounds and combustion contaminants. These limits are:

Rule 53a. Sulfur compounds calculated as sulfur dioxide (SO_2): 0.2 per cent, by volume.

Rule 53b. 0.3 grain per cubic foot of gas calculated to 12 per cent of carbon dioxide at standard conditions.

The present limit of .3 grains was adopted on January 16, 1958; prior to this time the limit was .4 grains. This rule is one of the standards which must be met by the performance of any multiple chamber incinerator constructed for operation in Los Angeles County.

e. Rule 53.1 — Scavenger Plants

The rule sets forth the conditions under which a scavenger or recovery plant may operate under permit. Such plants are built in Los Angeles County to recover sulfur products, which might otherwise be emitted to the air.

f. Rule 54 — Dust and Fumes

This rule establishes the maximum allowable limits for the discharge of dusts and fumes according to the process weights of materials entering the process. The maximum allowable limit in pounds per hour are graduated according to the weights of materials processed per hour. The maximum emission allowed under Rule 54 is 40 pounds per hour where 60,000 or more pounds are processed in the equipment in any given hour.

g. Rule 56 — Storage of Petroleum Products

This rule sets forth the type of control equipment that can be used for the control of hydrocarbons from the storage of gasoline and certain petroleum distillates. This rule provides that any tank of more than 40,000 gallons capacity used for storing gasoline or any petroleum distillate having a vapor pressure of 1½ pounds per square inch absolute or greater, must be equipped with a vapor loss control device. This rule also provides for the installation of floating roofs, vapor recovery systems, or other collection equipment of equal efficiency.

h. Rule 59 — Oil-Effluent Water Separators

This rule regulates the type of control equipment that can be used for the control of hydrocarbons from oil-water separators. It provides that such equipment must either be covered, provided with a floating roof, equipped with a vapor recovery system, or equipped with other equipment of equal efficiency provided that the effluent water handled by the separator contains a minimum of 200 gallons per day of petroleum products.

i. Rule 61 — Gasoline Loading into Tank Trucks and Trailers

This rule sets forth the type of control equipment that can be used for the control of hydrocarbons from the loading of gasoline into tank trucks. It provides for the installation of vapor collection and disposal systems on bulk gasoline loading facilities where more than 20,000 gallons of gasoline are loaded per day and requires the loading facilities to be equipped with a vapor collection and disposal system. The disposal system employed must have a minimum recovery efficiency of 90 per cent or a variable vapor space tank compressor and fuel gas system of such capacity as to handle all vapors and gases displaced from the trucks being loaded.

j. Rule 62 — Sulfur Content of Fuels

This rule bans the use of high sulfur fuel oils seven months each calendar year. The rule bans gaseous fuels containing sulfur compounds in excess of 50 grains per 100 cubic feet of gaseous fuel (calculated as hydrogen sulfide at standard conditions) or any liquid fuel or solid fuel having a sulfur content in excess of 0.5 per cent by weight. This rule is in effect beginning with April 15, and ending with November 15, a period in which natural gas is in supply.

k. Rule 63 — Gasoline Specifications

This rule prohibits the sale and use of fuel for motor vehicles having a degree of unsaturation exceeding a bromine number of 30 after June 30, 1960, and a degree of unsaturation exceeding a bromine number of 20 after December 31, 1961.

l. Rule 64 — Reduction of Animal Matter

This rule requires that malodors from all equipment used in animal rendering be either incinerated or processed in an odor-free manner under conditions stated in the rule.

m. Rules 57 and 58 — Open Fires and Incinerators

These rules ban the burning of combustible refuse in the Los Angeles Basin in open fires and single-chamber incinerators.

REGULATION V — Procedure Before the Hearing Board

The California State Health and Safety Code specifically authorizes and outlines the functioning and purposes of the Air Pollution Control Hearing Board. Regulation V of the Rules and Regulations further outlines the procedures to be used by the Air Pollution Control District before the Hearing Board.

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[w] Particulate matter may be defined as any material, except uncombined water, which exists in a finely divided form as a liquid or solid at standard conditions. Combustion contaminants are defined by the Rules and Regulations as particulate matter discharged into the atmosphere from the burning of any kind of material containing carbon in a free or combined state.

The Air Pollution Control Hearing Board is an administrative tribunal with power limited to the adjudication of the actions of the control district. The Hearing Board is not organizationally connected to the Air Pollution Control District, but assumes precedence over the District in issuing decisions in specific cases. The Hearing Board is appointed by the Air Pollution Control Board (the Board of Supervisors) and consists of three members. Two members are admitted to the Hearing Board who practice law in the state, and a third member is a chemical or mechanical engineer.

The purpose of the Hearing Board in general is to weigh equities involved in the rights of individuals in conflict with the provisions of Chapter 2, Division 20, of the State Health and Safety Code and the Rules and Regulations of the Air Pollution Control District. The Hearing Board is thus given the power in individual instances to permit variances of the law, to hear appeals made when denials for permit applications have been issued by the District, and to weigh cases in which the District seeks revocation of permits. The decisions of the Hearing Board do not involve fines or imprisonment, but are intended to direct both the District and the petitioner in a course of action which will abate air pollution within the limitations of both public and private property rights.

The decisions of the Hearing Board are not absolute and may be tested further in the courts. Either the individual or the Air Pollution Control District itself may file a special proceeding in the Superior Court to determine the reasonableness and legality of any action of the Hearing Board. The persons taking such action are then entitled to a completely new trial in obtaining an independent determination of the reasonableness and legality of the Hearing Board action. The decisions of the Superior Courts, of course, can be further appealed.

Regulation VI — Orchard or Citrus Grove Heaters

This Regulation deals with the discharge of unconsumed solid carbonaceous matter from orchard heaters. This regulation was enacted in the fall of 1949 following the cold period in the winter of 1948-1949, when householders in the citrus area of the Los Angeles Basin requested that action be taken to solve this problem through the Air Pollution Control District.

It should be pointed out that in the citrus areas of California and Florida, orchard heating equipment is utilized on nights when the temperature falls below freezing to prevent frost damage to crops and trees. When Los Angeles County was predominantly agricultural, a black pall of smoke from these sources was apparent on mornings following the frost, even in downtown Los Angeles area. This regulation limits emissions from orchard heaters to 1 gram per minute and specifies procedures and conditions for obtaining permits, and prohibits or qualifies the use of certain makes of heaters.

Regulation VII — Emergencies

This regulation was advanced and adopted in 1954 as a result of widespread concern among the general public, lay groups and medical groups that Los Angeles might be approaching a London-type disaster. Although later evidence has failed to substantiate this view, the concern was great enough that the 1954 Grand Jury urged the establishment of an official and orderly disaster-prevention program by the County Air Pollution Control District. This regulation is probably the first air pollution legislation of this type.

The regulation is designed to prevent the excessive buildup of air pollutants and to avoid any possibility of a catastrophe caused by toxic concentrations of air contaminants. It describes procedures required for the sampling and measurement of toxic air pollutants; declaration of alert stages; notification of law enforcement agencies and other local public officials; curtailment of rubbish burning, vehicular traffic, and shutdown of industry; and other activity contingent upon a state of emergency.

The responsibility for the disaster-prevention program rests with the Air Pollution Control Officer and the District. This responsibility in the rules contained in this regulation specifies various requirements. These are:

a. That an air sampling network be established and maintained, consisting of at least six permanently located stations which monitor the atmosphere continuously for four specific contaminants — ozone, sulfur oxides, nitrogen oxides and carbon monoxide. The alert stages for the toxic levels of these contaminants are shown in Table I-15, page 33.

b. That the Control Officer develop detailed plans calling for the shutdown of significant air pollution sources in the event "alert stages" are reached for any of the four contaminants enumerated in the rule. According to which alert level is reached, the District initiates the appropriate action:

(1) During the first alert level the regulation prohibits all refuse burning within the limits of the Los Angeles Basin and requires the Control Officer to secure the voluntary cooperation of the public in limiting use of all privately-owned vehicles.

(2) During the second alert level the Control Officer requests industrial establishments to implement "voluntary" shutdown plans and in the event the implementation of these plans fail to halt rising concentrations of contaminants, the Control Officer is authorized, with the advice of a special "emergency action committee" and with the approval of the Air Pollution Control Board,

to implement compulsory curtailment activities as may be necessary.

(3) During the third alert level the Air Pollution Control Board requests the Governor to declare a state of emergency and is authorized to take vigorous police action as set forth in the California Disaster Act.

c. The Control Officer was given the further responsibility for communicating alert levels to the public and to principal law enforcement agencies by means of the Sheriff's teletype and radio systems, air polluting industrial plants and processes which require "alert" data in order to effect prearranged plans designed to reduce the output of air contaminants, and to Air Pollution Control District personnel. Under Rule 155.2 of this Regulation various industrial categories are listed which are required to maintain radio communication systems capable of receiving messages of the Air Pollution Control District's base station.

d. The final responsibility assigned to the Control Officer involves the continuing revision, adjustment, and improvement of the disaster-prevention program. To assist the Control Officer in this respect, a fifteen-member scientific committee was activated under the regulation, consisting of medical and air pollution experts. This committee was entrusted with the responsibility for studying and recommending to the Control Officer the most "suitable methods for measurement of air pollutants" and for recommending any changes in the alert standards.

In order that the Air Pollution Control District fulfill its responsibility in enforcing the Rules of this Regulation, enforcement personnel are equipped with emergency vehicles and two-way radios. It is the task of the Enforcement Division of the Air Pollution Control District to enforce the provisions of the Regulation. Rule 161, for example, states:

> When an alert has been called the Air Pollution Control Officer, the Sheriff, their deputies, and all other peace officers within the Basin shall enforce the appropriate provisions of this regulation and all orders of the Air Pollution Control Board or the Air Pollution Control Officer made pursuant to this regulation against any person who, having knowledge of the declaration of an alert, refuses to comply with the rules set forth in this regulation or any order of the Air Pollution Control Board or the Air Pollution Control Officer made pursuant to this regulation.

The principal provisions enforced under Regulation VII are Rule 157, first alert, Rule 158, second alert, and Rule 159, third alert; and any "order of the Air Pollution Control Board or the Air Pollution Control Officer made pursuant to this regulation." The enforcement procedure and the data gathering activities in enforcing these rules are dependent upon the conditions which obtain during the state of emergency and the exact nature of the orders given by the Air Pollution Control Officer.

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CHAPTER FOUR

ELEMENTS OF THE AIR POLLUTION CONTROL PROGRAM

Once a control authority has been established, it will devise a plan of action; i.e., a comprehensive air pollution control program. The control program will be based partially on the past history of control efforts in other communities, and partially on the need for special solutions to problems unique to the community. Regardless of such considerations, however, the basic elements of an officially sponsored control program remain the same from community to community. These are:

1. **Research and Investigation.** Identification and evaluation of causes and effects of, and solutions to, both the community-wide air pollution or smog problem, and specific or localized air pollution problems.
2. **Control Standards.** Promulgation of control standards based on confirmed research findings and air quality standards.
3. **Source Registration.** Registration of the sources of air pollution in order to determine pollution potentials for (1) locating the need for remedial or preventive measures, (2) estimating trends in pollution potentials and atmospheric concentrations, (4) establishing evidence for anti-pollution legislation, and (5) planning field control operations.
4. **Field Control Operations.** Inspection of the sources of air pollution and enforcement of the air pollution law to obtain minimum pollution potentials and solutions to specific air pollution problems.

Although the elements of the control program are more or less fixed, control policies vary in strictness, scope, and depth from community to community, and, from time to time within the same control agency. The differences in policy may be seen in terms of two situations. On the one hand, standards resulting from a control program may be few in number, easy to comply with, flexible and applicable only to some sources of air pollution, while on the other hand, legal standards may be certain, inflexible, strict, and apply to all.

Where there are relatively few sources of air pollution, as in a medium or small sized community, air pollution problems may be handled with a minimum of government-sponsored control. These communities may provide only a few legal sanctions such as the public nuisance or visible smoke regulations, in addition to an inspired clean air campaign. Control of this nature may be effective to the extent that control techniques may be applied with little cost to the community, limited perhaps to operational and maintenance control.

In complex metropolitan problems, like those in Los Angeles, New York, and St. Louis, however, air pollution control programs cannot be so loosely administered. As the air pollution problems in these communities become severe, the demands made on the control program increase. In the Los Angeles problem, for example, a stringent and thoroughgoing program evolved due to the increasing impact of smog-producing factors. The state and local law which evolved permitted the Los Angeles County air pollution control program to be more restrictive than has been possible in many other areas of the nation. As a matter of fact, few control regulations have been enacted in which economic considerations dominated. By denial of operating permits and injunctive action, specific pollution sources have been completely eliminated. In the case of certain metallurgical operations the cost of the required control equipment has exceeded the cost of the equipment which it was designed to control.(9)

I THE IDENTIFICATION AND ANALYSIS OF SPECIFIC AIR POLLUTION PROBLEMS

The first approach taken to any air pollution problem must identify the air pollution problems which exist, determine cause and effect, and investigate means for control. This is fundamentally the research phase of the control program. By research is meant both a systematic investigation into the causes and effects of air pollution, and the analysis and interpretation of such data for the purpose of developing legislation, controlling sources of air pollution, and guiding control operations. The term "research" here may be used quite broadly — it may mean only the conduct of an impartial and objective study or survey of an air pollution problem which may be relatively simple in nature, or a major scientific task requiring the utilization of skills and disciplines from various technical fields. The research phase may involve short term projects which terminate upon the assembling of the required data, or long-range or permanent programs geared to such functions as continuous monitoring of the atmosphere, and sampling of contaminants from ducts and stacks of stationary sources.

The number of variables in the pollution problem determine the research requirements. When the number of sources of air pollution are pinpointed and are manageable in number, an objective presentation of the available data by means of such a device as a survey may be all that is required to set about establishing effective control standards. When, however, the sources of pollution are "infinite" in number and indefinitely diversified in character, the relationship of the polluted atmosphere to all of the ground sources may not be ascertained by such superficial means of analysis. Well organized and detailed research projects are required. Regardless of the extent of the need for a research project, however, it will be necessary to conduct some type of scientific or objective investigation. Even where the sources of pollution are few in number, it may be necessary to make a detailed analysis of the polluted atmosphere as a means of providing evidence that the atmosphere is polluted, and by certain definite contaminants, before legislators or boards will promulgate and adopt specific measures.

Occasionally, a community may find that it is experiencing a complex problem for which there is no precedent. The control agency may be required to engage in original research sponsored by either local or state government or by contract with private research agencies. Whichever is the case, local government may only afford to conduct such research as will prove the causes and effects of its air pollution problem.

The extent to which an original research program may go into specific areas may be considerable, however. The agency may find it necessary to develop special techniques in such fields as instrumentation and calibration, laboratory methods, special testing and measuring techniques, and other basic scientific or technical work in order ultimately to achieve its broad objectives. Analytical methods applied to the field of air pollution from other fields such as industrial hygiene and toxicology may require rigorous evaluation and modification.

In this chapter the research program will be viewed in terms of a typical research project. In general, this is conducted in the following steps or stages: (1) determining purposes and objectives, (2) gathering data, (3) analytical laboratory analysis, (4) reduction, analysis, and interpretation of data, and (5) presentation of findings.

A. Determining Purposes and Objectives of Research

The research program may be viewed as a systematic means of answering certain questions. The first questions, of course, which may have to be answered are natural and predictable, such as: "What pollutants are in the air and in what quantities?" "What meteorological factors serve to accumulate or disperse the pollutants in the air?" "What climate and weather conditions unique to the area serve to intensify or relieve the problem?" "Where do the contaminants come from?" "How can the sources of pollution be controlled?" All initial surveys or studies of any air pollution problem will be devoted to seeking answers to these questions. To answer them, the control program may be required to accomplish the following:

1. Identify air contaminants and measure their concentration in the atmosphere for purposes of determining pollution thresholds and air quality standards.
2. Survey the sources of pollution in the pollution zone in order to determine pollution levels, potentials, and relative contribution.
3. Compare pollution levels in various portions of the pollution zone at various times and with other cities to determine critical areas.
4. Monitor levels of various key contaminants by means of both manual and automatic sampling equipment in order to determine when alert or toxic levels of contaminants are reached to protect the public in case of disaster, and to determine patterns of peak and average concentrations.
5. Determine improvements resulting from control techniques and the field operations control program.
6. Gather data as are essential in providing a basis for forecasting air pollution or smog conditions on a daily basis.
7. Determine factors necessary for correlation such as wind trajectories, pollution concentrations, eye irritation, etc., for control development purposes, such as zoning of source areas.

B. Gathering Data

In the research phase of the control program, most of the basic data compiled concern three primary facets of the air pollution problem: air contaminants, atmospheric conditions, and equipment operation. Other factors, of course, are studied to provide checks on the data gathered, or to verify assumptions made from data acquired from the basic data gathering techniques. It is interesting to note that in research, generally similar and identical principles tend to be employed in the sampling of contaminants in the atmosphere, the sampling of stack gases, and in the mechanics of the various control devices. Thus, there is a core of scientific principles, peculiar to air pollution control, such as sedimentation and settling, inertial and centrifugal collection, filtration, electrostatic precipitation.

The following types of data gathering activities are germane to the research program:

1. Atmospheric Sampling and Air Analysis

This involves the sampling of the atmosphere for air contaminants, or the continuous monitoring of certain key contaminants at permanent locations in the pollution zone, and the laboratory analysis of samples collected. Sampling may be made of a homogenous smog blanket, a local condition, pollution from a specific plant or industrial area, or background pollution when all of the air pollution activities are at a minimum.

The trend in air analysis is toward the development of automatic sampling devices, which not only offer continuous around-the-clock readings of certain contaminants, thus providing invaluable data for evaluation purposes, but also eliminate the labor and time consumed in conventional analyses of manually collected samples. These highly sophisticated, but sometimes temperamental, instruments require, however, continuous and careful calibration, adjustment, and maintenance on the part of skilled technicians.

2. Source or Stack Gas Sampling

Source sampling concerns the sampling of effluents from stacks and ducts at the sources of air pollution to determine (1) compliance with standards, and (2) emission factors and pollution potentials of equipment. Source sampling requires special techniques for the collection of a representative sample of contaminants from each source being tested. This procedure is used in making both qualitative and quantitative determinations.

Figure IV - 1. APCD testing crew performs a stack test at a chemical plant.

3. Weather Measurements

Weather observing stations are employed to obtain data of relevance to the direction and distribution of contaminants in the atmosphere. Ordinarily such data comprise inversion conditions, temperature, solar radiation, humidity, wind and atmospheric stability, etc. These data are used in making "smog forecasts" as well as plotting trajectories of polluted parcels of air for land use studies, high concentrations, etc.

4. Photographic Analysis

Various photographic techniques can be used to study the visual character of air pollution in a community. Time-elapsed photography can be used to compare the hourly differences in visibility at a certain location to illustrate the manner in which a haze or smog builds up as a result of the diffusion of contaminant plumes from various industrial sources, or it can be used to study plume formation and plume characteristics, as well as to locate primary sources of air pollution in a community. The inferences which can be drawn from photographic techniques, however, are limited to the effect of visibility reduction. Photography also can be used to map topography and smog flows and in revealing violations of the law in enforcement operations. Photography is a useful adjunct to other analytical and investigative techniques, but is of limited value in itself.

5. Survey of the Industrial Economy

Surveys involve the analysis of selected data of the entire industrial, commercial, and domestic sectors of the economy to determine total and relative pollution potentials. It is acquired either by a questionnaire, by means of a canvas or inventory inspection, or by analyses of data acquired from other agencies. Surveys catalog and quantify the air contaminants as a basis for computing the air pollution potentials of specific industries or operations.

6. Analysis of Damage to Life, Property and the Environment

Invaluable analytical and experimental tools in research are the studies made of the damage or effects of air pollution on life (crops, plants, animals, and humans), property, and the environment. A study of these effects not only supplies clues as to the nature of the important and possibly unknown contaminants, but can be used to measure concentrations and areas of widespread contamination.

7. Public Surveys

Various types of surveys and polls can be taken of the public in general, or from such specialized publics as managers and operators of businesses or industries, for the purpose of obtaining data required by the control program. Opinion may be sampled to relate subjective experiences to measurable phenomenon. For example, eye-irritation can be rated and correlated with known contaminant concentrations. Surveys can also be used to sample a specific neighborhood in evaluating a local source problem. A community or neighborhood may be systematically canvassed to determine frequency, direction, and severity of an odor or contaminant in assessing nuisance value. (See Chapters 8 and 12.)

C. *Laboratory Analysis*

The control agency will require laboratory analytical services either on a contract basis or will conduct such activity itself. Where the scope of the research activity is extensive and involves original analysis, it may be best that such research be contained within the administration of the control agency, since many techniques will require special development and integration with other phases of the control program.

In the laboratory analysis of samples of contaminants collected under experimental or field conditions, various methods are used. Some are conventional *qualitative* and *quantitative* methods established in the field of analytical chemistry. Others are particular modifications or original developments adapted specifically to the field of air pollution or related fields, as described in such publications as the American Society for Testing Materials' (ASTM) STANDARD METHODS OF ANALYSIS, University of Michigan's ENCYCLOPEDIA OF INSTRUMENTATION FOR INDUSTRIAL HYGIENE, and in publications produced by private agencies such as SHELL METHODS SERIES, FLUOR LABORATORY METHODS, and the Los Angeles County Air Pollution Control District's LABORATORY METHODS. These methods are used to determine the identity and quantity of an element or radical of a substance by methods involving the following principles:

1. Assay to identify metals by means of heat treatment and use of various reagents.
2. Organic methods used to determine solubility, or resistance to solubility of a substance.
3. Reactions to acids, bases, certain salts, or other chemicals.
4. Measurement of certain characteristics such as color change (colorimetry), texture, odor, hardness, density, etc.
5. Tests of other physical properties such as melting, boiling, sublimation, decomposition, etc.

The basic problem in conventional laboratory analysis, however, is the errors which result from concentrating the contaminants collected in the sampling process. To a certain degree, such errors may be statistically compensated, but there remains an uncertainty as to the accuracy of the results. Considerable progress has been made toward devising analytical techniques which do not alter the contaminants or the atmospheric conditions under which the air sample is being analyzed, and which are capable of identifying and measuring samples containing concentrations in the order of parts per million. This requirement has, in part, influenced the development of a special field of analytical chemistry known as microchemistry and ultra-microchemistry. In these fields, special instruments based on absorption and infra-red spectrophotometry and gas chromatography have been developed.

A special long-path infra-red spectrophotometer which can identify compounds in concentrations as dilute as one part in two million is employed by the Los Angeles County Air Pollution Control District laboratory. This device operates on the principle that compounds absorb specific light waves from the beam passed through them. A precise measurement of the wave-lengths absorbed identifies the compounds. With this device, the progress of reactions in dilute concentrations comparable to those actually found in the atmosphere is studied.

D. *Reduction, Analysis, and Interpretation of Data*

The research program will be required to provide some means whereby it can digest all of the information obtained from the data gathering activities, and evaluate the meaning and significance of the raw results. These findings answer such questions as "In which portions of the day or year do contaminants reach their peaks?" "Which contaminants or classes of contaminants?" "Are the concentrations in the atmosphere of one or more contaminants rising?" "How do contaminant concentrations correlate with eye-irritation, plant damage, weather factors, etc.?" "How do the parcels of air move over the pollution zone, etc.?" Because of these questions, and the multifaceted character of the air pollution problems, the research program will be devoted to conducting various categories of quantitative measurements to be correlated, and which lend themselves to statistical and comparative analysis.

In Los Angeles, the raw data obtained from the data gathering activities — contaminant concentrations, pollution potentials, meteorolgical factors, eye irritation severity, and plant damage — are fed to an electronic computer which is capable of reducing, summarizing, and correlating tremendous quantities of data to statistical norms (maximum values, peaks, averages, means, medians, modes, etc.)

In general, the methods of analysis applied to data depend upon the objectives and purposes for which the data were collected. Considering such purposes, the problem of statistical analysis is to determine the validity, reliability, and reproducibility of the results. Occasionally, the results may be found to be invalid, inconclusive, subject to qualification, and may suggest further types of tests or refinement of test methods to attain a higher degree of validity. When the results are rigorously established, however, they may then be used as a basis for control action.

E. *Presentation of Data*

With the evaluation and interpretation of data, the research phase is only half complete. The information, to be of any value, must be translated into both legal and lay language for those who are responsible for control planning. The importance of preparing the information so that it can be comprehended and accurately understood, especially by other elements of the control program, cannot be overemphasized. The administration of a technical organization like an air pollution control agency serves as the agent of such research results in assuring that the proper control action is being taken.

II PROMULGATION OF CONTROL STANDARDS

The next step in the control program is the utilization of the rule-making authority to promulgate control standards into law (ordinances, rules and regulations, codes, etc.). Legal standards are the direct result of well established research findings pertaining to the range of pollution levels, the sources of air pollution, the causal factors of air pollution phenomena, and the various means possible for control. These are translated directly into simple and clear expressions of prohi-

bition, giving dates of adoption, the dates laws become effective, and whatever conditions or exceptions as make the intent of the law clear. The law, furthermore, must clearly include all persons upon whom it is binding, and exclude those who need not comply. These laws are usually drafted by the control agency, or the agency with the research facility, and are either used as models for adoption by local authorities or are forwarded from the control agency to the rule-making authority for approval and adoption.

In developing control standards, the following factors are specifically taken into account:

1. **The category or identity of contaminants to be prohibited.**
2. **The maximum allowable emission rate.**
3. **The most effective control techniques available.**
4. **Legality, feasibility, and enforceability of the legal standard.**

A. The Category or Identity of Contaminants to be Prohibited

The analysis of the pollution potentials of the pollution zone and smog-forming phenomena indicates the specific classes of contaminants which must be controlled. In complex pollution problems, control standard are approached from two points of view: (1) standards which are applied to air contaminants collectively, and intended to accomplish gross reductions of air pollution; and (2) specific standards applied to special contaminants or equipment. Control standards, therefore, may encompass the following classification of contaminants:

1. **All air contaminants as defined by the control law.**
2. **All visible air contaminant emissions.**
3. **Any quantity of air contaminants which creates a public nuisance.**
4. **All solid and liquid particulates.**
5. **Certain gaseous contaminants.**
6. **Specific contaminants.**

Although it is the ultimate purpose of the control authority to control or reduce all air contaminants, it is impractical to prohibit "all air contaminants" by a single inclusive rule or law. Contaminants must be meaningfully qualified by law. That is, we must speak of *visible* contaminants; the *physical* form of the contaminants, such as fumes, dusts, mists, smoke, gases, and vapors; we may speak of *any* quantity of contaminants which may create a nuisance to a considerable number of persons or damage health, property, vegetation, etc.; or we may be concerned with a *specific* contaminant or an entire *class* of contaminant compounds.

The contaminants are either clearly identified or directly implied in the standards, so that all involved in assuring compliance understand what must be controlled. The contaminant is always identified, of course, where standards of maximum permissible emissions are involved. Where equipment or fuel regulation is involved, however, the contaminant may not be specifically mentioned.

B. The Maximum Permissible Emission Rate

All laws which relate to the control of air contaminants at the sources of air pollution must embody directly, or be based on, a maximum permissible emission rate. The permissible emission rate may either be derived from (1) the maximum allowable concentrations of atmospheric contaminants which are either toxic or which contribute to the formation of toxic contaminants, or (2) an assessment of what emissions are *excessive* in terms of the nature and operation of the individual sources of pollution.

Varying degrees of mathematical precision are employed in objectively computing the quantitative standard in the rules. These may be expressed in terms of (1) emission rates vs. atmospheric concentrations of the same or related contaminants, (2) effluent concentration and stack height vs. ground concentration in the vicinity of the source, and (3) opacity standards vs. atmospheric visibility. Where it is not possible to wholly base legal standards on strictly mathematical considerations, the rule-making authority may use its discretion in terms of what is reasonable and prudent. Particularly is this true when standards are based on considerations of "excessive" emissions. The object may be to obtain the greatest degree of emission reduction at the individual sources of air pollution consistent with what can be technically or scientifically accomplished.

1. Emission Rates vs. Atmospheric Concentrations

The attempt is made here to reduce concentrations of primary and secondary contaminants to a desired level by adopting standards which proportionately allocate maximum permissible emission rates among the individual sources. For example, suppose that a satisfactory improvement in pollution conditions can be achieved by reducing the total pollution potential to Y tons which is possible if a given control device is employed on all of the sources, which are N in number. An emission rate of Y/N, expressed in terms of pounds per hour, grains per cubic foot of stack gas, or per cent of volume, and adjusted to allow for growth and other factors (since N represents a changing quantity), may then be used as the control standard. The standard may be directly written into rule, the responsibility for maintaining this standard of performance being left to the operator, or the rule may require the operation of such controls or control techniques as will automatically accomplish this reduction. To certainly realize desired reductions in pollution levels, the trend in control regulation has been toward equipment or fuel regulation.

2. Effluent and Stack Height vs. Ground Concentrations

Early in the field of air pollution control Sutton and Bozanquet(12) established mathematical formulas which could be applied at each source to determine, on the basis of stack height and stack concentrations, the distance a plume of smoke or fumes reaches the ground, the distance at which the maximum concentrations are reached (usually eight to ten times the stack height in still air), as well as variations in concentration with distance. These formulae were based on assumptions of atmospheric stability, flat terrain, etc. Other variables, of course, are accounted for in increasing the validity of the criteria. This type of standard, therefore, represents a mathematical basis for determining excessive emissions.

These formulas have found some application in Europe, particularly in Holland(5), where congested communities are directly affected by the plumes of smoke emitted from the stacks of large coal burning plants. In these instances, air pollution is reduced by building taller stacks, or the maximum permissible emission allowed is based on the height of the existing stack. The shorter the stack, the less emissions allowed. For example:

$$\text{Maximum emissions allowed} = \frac{\text{height of stack}^2}{50}$$

Where height is expressed in meters and emissions in grams per cubic meters. Furthermore, the emission of particles larger than 50 microns (in Holland) must be:

$$\text{Maximum emission} = \frac{\text{height of stack}^2 \times 0.025}{50}$$

Although these principles may be considered in setting standards, they are not directly written into law in the United States due to the difficulty involved in enforcing such legislation, and the fact that air pollution does not originate from stacks and chimneys only, but from many types of outlets at ground levels. A single opacity standard applied directly at the outlet of the stack is considerably more effective in the advent of recent types of air pollution problems.

3. Opacity Standards vs. Atmospheric Visibility

Although the Ringelmann standard, developed by Professor Ringelmann in the late nineteenth century, and officially published by the United States Bureau of Mines, was originally devised as a means of determining power plant efficiency, its adoption and popularity appear to be based on the assumption that contaminant plumes can be attacked from the point of view of improving visibility. The Ringelmann standard was thus available to provide a standard based on the obscuration of vision of contaminant plumes directly at the sources of air pollution. (See Chapter 10 for a complete explanation of the Ringelmann system.)

The Ringelmann scale, designated by panels increasing in darkness of shade in six equal steps (from "0" through "5" inclusive), provides a standard which can be used in drawing the line between permissibility and prohibition in terms of one of the six panels and a time limit. For example, the Los Angeles ordinance (Rule 50) prohibits smoke in excess of #2 Ringelmann for more than three minutes in any one hour. The problem here is, how are such standards determined? Is any specific Ringelmann panel arbitrary, or is there a definite mathematical relationship between observed phenomena and the Ringelmann panels?

Actually, such standards are neither entirely predetermined, nor are they completely arbitrary. The choice in the panels can be logically narrowed. Ringelmann designations "0" and "1", which are close to complete transparency and the minimum of pollution, and designations #4 and #5, which are perfect or near perfect opacities, may be eliminated as extremes. The standard of prohibition, therefore, is chosen from panels #2 and #3. A control program with strict requirements will favor the #2 Ringelmann standard, and a relatively shorter time allowance. The American Society of Mechanical Engineers in 1949, after eight years of study, published "Example Sections from a Smoke Regulation Ordinance" as an aid to communities considering smoke regulation ordinances. In Section 8 of this bulletin "smoke the appearance of which is equal to or darker than #2 of the Ringelmann Chart" is prohibited except for limited periods under certain conditions. This bulletin has been used as a basis for smoke ordinances in more than 100 cities.

The Ringelmann standard is strictly a device for defining *excessive* emissions of *visible* contaminants. Since it can be assumed that invisible contaminants are reduced in effluent plumes as the opacity decreases, the Ringelmann standard is an effective overall rule that can be applied in controlling a wide variety of emissions. It is especially effective when applied to smoke, dust, fume, and mist emissions.

C. Control Techniques Available

The type of control regulations adopted, i. e., maximum permissible emission, public nuisance, and equipment and fuel regulations, depend on the development and availability of the control devices to the sources of air pollution. Here the design parameters and other engineering factors involved in the control of air pollution directly determine the wording and character of the legislation. The control standard may make the control of factors causing the emission of air contaminants mandatory by regulating an appropriate phase of the process or operation cycle of equipment — from the charge of the feed, fuel, material, and air to the equipment, the flow of these materials through the equipment, to the final discharge of contaminated air and other waste products accumulating at the completion of the cycle. The legal standard may require the operator to accomplish a *specific* change on the source, such as change of fuel, replace equipment, attach a control device, etc., in which case the contaminant reduction is presumed. Or the operator of the equipment may be required to accomplish any change at his own volition — including elimination of the equipment if correction is not possible — as may be necessary to bring about a reduction of contaminants to meet a maximum permissible emission standard. The former type of regulations apply to more specific situations, to classes of equipment or fuels, and the latter applies to all sources of air pollution simultaneously. To comprehensively control all air pollution through control regulation, it is necessary to include both types of regulations.

The control standard, to be reasonable, must consider the availability and practicality of such devices. The implementation of the standard must sometimes await the development of such devices to the point where they are capable of being standardized in industrial practice, or the development of a variety of approaches to the same problem so as to allow plant operators an economic choice. In more urgent problems, the control regulation may adopt performance standards upon the immediate development of a control device and state a deadline for compliance. In this way, steps toward control are immediately undertaken, and manufacturers of devices are encouraged to refine a variety of control methods for competition in the open market.

D. *Legality, Feasibility, and Enforceability of the Legal Standard*

While the foregoing represents objective criteria by which control standards may be developed, the standard may be modified by factors involving any other social, economic, political, or legal consequences resulting from the administration of the regulation. such as:

1. Constitutional and legal limitations.
2. Cost of control to the community, consumer, industry, and producers.
3. Efficiency of available control devices.
4. Uncertainty as to the presumed consistency of effects of pollutants on toxicity or nuisance.
5. Enforceability, i. e., the facility encountered in obtaining evidence as to violation and compliance.

With the exception of constitutional and legal limitations, such as due process of law, the standards are modified to favor either these considerations or the degree of control which has been objectively determined to be necessary. A strict control policy leads to the adoption of standards which are not only intended to obtain immediate and uniform results, but prevents the resurgence of air pollution problems, protects the health of a minority of persons who may be sensitive to low concentrations, and which positively weighs the need for, against the cost of, control. As we have seen from Chapter 1, control standards may be based on maximum and minimum pollution *potentials* by estimating the most adverse pollution possible under prevailing conditions. As more becomes known about the causes and control of air pollution, standards reflect more exact relationships between actual and desired conditions.

Regardless of the strictness of the control policy, all control standards, to be effective, must be enforceable. The regulations should contain few and clear restrictions, and these should be capable of being ascertained in the field. For this reason, fuel and equipment regulations are definitely superior to maximum permissible emission standards, since it is only necessary to determine whether the specified equipment or fuel is being properly employed. The Ringelmann standard, also, is highly enforceable, although legal questions are periodically raised in the courts concerning the validity of its use. Compliance with standards based on grain loading or gas volume are more difficult to ascertain in the field and require elaborate source testing. For this reason, these standards are applied more in granting and denying operating permits than in on-the-spot field determinations of compliance. Field measurement techniques, however, continue to be devised to make field detection and measurement possible. (See Chapters 11 and 12.)

In the promulgation of control standards, all of these considerations are taken into account and are assembled as facts and evaluations to be presented in testimony before the rule-making body. The opponents to the proposed control measure likewise assemble facts to demonstrate that the standard is unfair or has an adverse effect on the economy or industry. Therefore, the control program must continuously evaluate the effects on the community, both in anticipation and as an evaluation of the effects after the control standard has been in effect for a time. If a regulation has been found to have assumed an incorrect approach, or fails to do the job it was intended, or creates adverse effects on the community, it can be rescinded.

III REGISTERING THE SOURCES OF AIR POLLUTION

The success of the control program depends on the accuracy and completeness of data concerning the air pollution potentials of each of the sources of air pollution. Without such information, the control program lacks direction and purpose, and the results of control activity are uncertainly verified.

The registration process is intended to secure a detailed breakdown of the air pollution potentials. This information is used to:

1. Indicate specific sources, or classes of sources, of air pollution which require remedial action, or which indicate the need for action, or are potential or actual violators of air pollution law.
2. Determine the growth of the sources of air pollution, so that it may be checked, and to prevent potential air pollution problems.
3. Provide a sound basis for promulgating anti-pollution legislation.
4. Correlate pollution potentials with atmospheric concentrations of contaminants measured by the air monitoring program, and provide a statistical basis for measuring improvements in pollution levels as a result of control activity.
5. Provide a system for assuring uniformity and fairness of enforcement of air pollution laws, and completeness of source coverage.

In order that the registration of the sources accomplishes the above purposes, it will be required to compile for each single source of air pollution the following data:

1. Corporate or individual ownership or responsibility.
2. Location of the equipment source.
3. Complete identification and description of the equipment, including all important constituents, appurtenances, and other conditions which affect the emission of contaminants.
4. All data relevant in demonstrating and expressing the air pollution potentials of the equipment. These data may include the nature of process, rates of emission based on size of outlet and flow rate of effluents, composition and description of effluent, etc.
5. Some record of status to indicate the degree of compliance with the air pollution laws.

There is little disagreement among those interested or affected by air pollution control regarding the necessity for source registration, but there is considerable disagreement as to the methods by which the sources of air pollution should be registered. The conflict relates to the powers of the control agency to gather such data, and the rights of plant operators to secrecy. Depending on its control policy, a community may provide for any one or combination of the following methods of registration:

1. Plant operator supplies information on a voluntary basis as conditions change in the plant.
2. Plant operator supplies information as authorized and required by law, but only upon formal request.
3. Plant operator supplies information under order of the control agency, and as required by law.
4. All data acquired by field inspection personnel, with the necessary authority.

Basically, it is a question of whether or not the plant operator supplies the required information, or the information is acquired through legal force bv agents of the control agency. There are three basic registration methods: (1) survey, (2) inventory, and (3) permits or licensing systems.

A. The Survey

Surveys are applied to determine the size of an air pollution problem, and the sources where control should be emphasized. They are designed and implemented generally for specific purposes and specific industries, and since they may only be required to scale a problem from the information supplied by random samples or key industrial plants, they do not necessarily accomplish complete source coverage.

A survey generally is conducted by means of a carefully designed questionnaire which is sent to all of the sources of air pollution being considered and known from other references to exist at the time. The questionnaire requests specific information on equipment, its operation, raw materials used, time of operation, etc. Suitable calculations are then performed on the data so as to determine emission factors, pollution potentials, and other information desired.

The questionnaire technique, of course, is subject to several errors, and large discrepancies may be found which will require correction. Notably, there is uncertainty regarding completeness of the sources, accuracy, and in the response to questionnaires, particularly by mail. Approximately 60 per cent of these queried will respond to a first mailing of a questionnaire. A second request, using a little more blunt language, usually provides an additional 35 per cent. It then becomes necessary for field personnel to visit the sources to determine if the companies are still in business and if the sources are in operation, etc. Of course, the questionnaire need not be mailed, but can be filled out by field personnel and plant operators, unless the information requested is of such a nature as to require an allowance of time for purposes of investigation or analysis.(2)

The survey technique, despite its inaccuracies and incompleteness, is a rapid means of gathering information for a specific operation and key segments of the data can be verified by spot-checking inspections. But it is doubtful whether surveys can be used alone as a means of obtaining complete and accurate source data. Nor can it form a solid legal basis for the enforcement of the laws of specific sources of air pollution. Surveys can lead to control, but do not constitute a control force in themselves.

B. *Inventories*

The inventory inspection is intended to specifically provide some accurate data on all equipment sources of air pollution in all industrial-commercial establishments in the pollution zone by means of direct contact with the sources of pollution by field personnel. The inventory inspection is conducted on a systematic plant-by-plant, equipment-by-equipment basis. The equipment is inspected and listed on inventories or equipment lists. Such lists supply the information required for each source as previously described. In addition to such data, the inventory inspection provides an excellent opportunity to make a thorough analysis of the status of compliance or noncompliance at each of the equipment sources so that potential or actual violators of the laws are detected (see Chapter 14).

In general, the inventory list is headed according to a plant activity and the equipment units are each listed and identified, so that the inventory inspection is essentially limited to what can be more or less ascertained by means of the direct senses at the time of inspection. The inventory, then, is used primarily to determine the identity, number, and nature of the sources of air pollution, and such additional information as may prove consistently useful in noting status of compliance with the air pollution control laws.

Air pollution potentials can be roughly estimated on the basis of inventory inspections, but not very accurately. Moreover, inventory inspections do not, in specific instances, provide enough data to determine compliance with those regulations based on dust loading, grain loading, or gas volume, as can only be determined by a thorough analysis of plans, specifications, and other engineering data on each equipment source and by actual source testing. However, such violations can be reasonably suspected by indirect evidence to one who is experienced in making inventory inspections.

The inventory inspection thus works toward completeness and currency of information, since the sources of air pollution are periodically and systematically visited, but may be limited in providing all of the data required for registration.

C. *Permits or Licenses*

The question of a permit or licensing system, as traditional as such systems are with respect to other fields of enforcement, is whether or not the sources of air pollution are to be properly and certainly registered. The permit system is the most effective means of registering sources of air pollution in that there is no question that the sources of pollution are being registered, no haziness or doubt about the information being submitted, no question concerning which equipment should be registered and when, no problem concerning the responsibility for veracity and good faith, and no time lag between the time such information may be required and the time it is received.

In the permit system, the applicant registers a source of pollution by submitting performance and operational data suitable to an accurate determination of both the pollution potential and compliance with control standards. If the equipment cannot comply with the control standards, the permit or license is refused, and the equipment cannot be legally operated within that control jurisdiction. To obtain a permit or license, the operator must either bring the equipment up to standard or replace it by more effective equipment. The permit system, thus, has control over the entire piece of equipment. It is an effective control weapon in that, while it registers the sources of pollution, it systematically eliminates from use equipment with high pollution or nuisance potentials, or equipment which may chronically violate air pollution laws. The permit system, therefore, is a means of remedying existing pollution problems and preventing future problems from occurring. The value of the permit system is indicated by its direct effect on checking the growth of sources of air pollution, particularly when there is a significant growth factor to be considered in the pollution zone. In Los Angeles County, an average of ten per cent of all permit applications received are denied, indicating the eradication of numerous pollution problems.

In general, a complete permit system will require that specifications and plans be submitted prior to actual construction of the equipment source for permission to construct. If a thorough review of the plans and specifications shows, in comparison with past experience with other sources of the same nature, that it may operate without violating any of the prohibitions, including a public nuisance, such authority is granted. Upon completion of the equipment source, and prior to actual use, a field inspection is conducted to verify construction and operational details and to observe the equipment in operation. If the equipment complies, an operating permit is issued.

There are variations to this procedure (the one outlined here is basically used in Los Angeles). Some permit systems do not require submissions of plans and specifications in advance, and issue only a certificate or operating permit. Some provide for authorization or suspension or revocation of a permit, but most do not. Some agencies may require fees, others do not. Basically, the intent of all such permit systems, however, is to provide for preventive means of controlling air pollution and to register the sources of air pollution.

Inasmuch as the permit system tends to give the control agency control over the entire piece of equipment, and since it may require the submission of plans and specifications, it has raised some significant objections*:

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* See also reference 4, p. 238 and following, and reference 7.

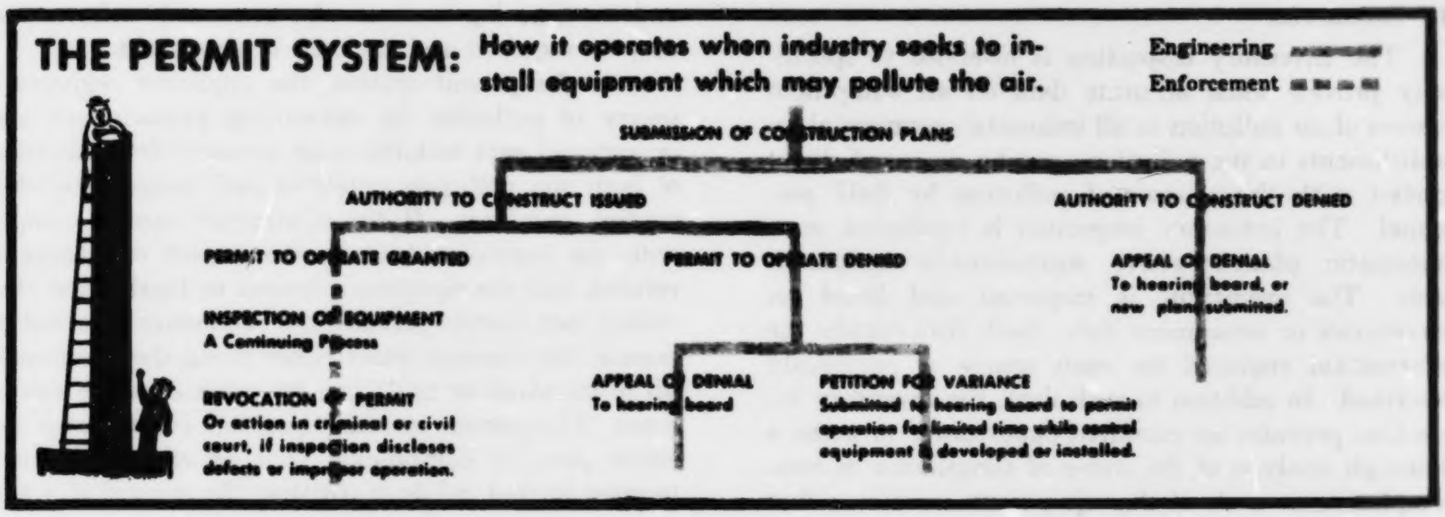
THE PERMIT SYSTEM: How it operates when industry seeks to install equipment which may pollute the air.
Engineering
Enforcement
SUBMISSION OF CONSTRUCTION PLANS
AUTHORITY TO CONSTRUCT ISSUED
AUTHORITY TO CONSTRUCT DENIED
PERMIT TO OPERATE GRANTED
PERMIT TO OPERATE DENIED
APPEAL OF DENIAL
To hearing board, or new plans submitted.
INSPECTION OF EQUIPMENT
A Continuing Process
APPEAL OF DENIAL
To hearing board
PETITION FOR VARIANCE
Submitted to hearing board to permit operation for limited time while control equipment is developed or installed.
REVOCATION OF PERMIT
Or action in criminal or civil court, if inspection discloses defects or improper operation.

Figure IV - 2. The Los Angeles County Air Pollution Control District permit system.

1. Applicants fear that the information which may be required may be of a confidential nature.
2. Applicants may fear that information may be used for purposes other than intended.
3. Many feel that the "red tape" involved in the permit system interferes with the freedom to seek the best control for a problem.
4. Many object to the assumption contained in the permit system that the burden of proving *compliance* may rest with the operator, which is contrary to the accepted notion of assumed innocence.
5. Others may feel that the permit system is dangerous in that it can be used as a power device by arbitrarily withholding permits.
6. Many feel that the permit system creates an unnecessary and expensive bureaucracy by requiring a large technical staff to review the plans and specifications in processing the permits.

The possible inconvenience resulting from the imposition of the permit system can be conceded. Certainly any *unnecessary* harshness in a law, as well as excessive administrative machinery, should be avoided. But two important considerations have, by now, been clearly settled: (1) that an air pollution law can go to such lengths as is necessary to control a given problem; and (2) constitutional safeguards are always present, in addition to those which may be built into the law itself. The stricter the law, the more the safeguards are usually clarified in order to prevent abuses, or aberrations in the administration of the control program. It is quite clear that neither blanket condemnation nor complete acceptance of the permit system means anything, unless they are made with respect to the pollution zone in question. A permit system, or its equivalent, will be required for an extensive pollution zone in which the sources of air pollution are highly diversified, "infinite" in number, and the industrialization and population of the community increases at a rapid rate. In other communities these factors may not be crucial, and the permit system may be considerably compromised, or avoided altogether, especially when other control techniques can bring about the desired results.

Objections to the permit system on the grounds of its harshness, arbitrariness, and its possible political uses are often met in the framing of the air pollution control law by providing definite safeguards, and by recourse to a hearing board, administrative tribunal, or the courts themselves. The California act, as we have seen, provides for a hearing board which operates independently of the air pollution control district. The rules also spell out the permit requirements and procedures, so that there is no uncertainty in the law.

Objections as to expense are not valid if it is understood that the specializations employed in reviewing applications provide a thorough and certain analysis of each air pollution potential, without which specific air pollution problems may not readily be solved.

In fact, experience has shown that the price paid for the enforcement of the permit system has been worth it in terms of the definite reductions in pollution levels and potentials it has accomplished. In fact, the permit system may be the leading and most effective control technique that can be used in a community with a serious air pollution problem.

IV FIELD CONTROL OPERATIONS — INSPECTION AND ENFORCEMENT

In order to certainly achieve the objectives of the control program, it becomes necessary to reach all of the sources of air pollution in the field to effect and to assure their control. This can only be accomplished by a field inspection and enforcement program. It is the purpose of this particular phase of the control program to obtain for the pollution zone the minimum pollution potential.

There may be some question as to the spirit and purpose of the law enforcement program based on the conflict between technical and police action considerations. What constitutes law enforcement may be controversial to the extent that, on the one hand, it may appear to the critic or to the public to lack strictness because of its absorption in technical considerations, especially when a chronic air pollution problem persists, and, on the other, as an excessive abuse or extension of police powers. In the former, it is felt that the air pollution problem will never be solved unless there are stringent laws and strict enforcement, and on the other, it is believed that air pollution problems are solved primarily through initiative in technical fields leading to voluntary control. Needless to say, both these positions beg the question by oversimplifying the purpose of enforcement.

We may define "law enforcement" as the detection, investigation, and prosecution of violators of the law — probably the strictest definition that can be given this term. The definition is qualified, of course, by constitutional and legal limitations, by application of common sense, a hearing board, and a variance procedure.

Essentially, this definition applies to air pollution control just as it does to police activity, so that the air pollution control agency is a law enforcement agency and an instrument of the police power of the state. However, the spirit of air pollution control enforcement, the attitudes involved in the enforcement of laws, may differ considerably from those involved in the commission of anti-social crimes such as murder, burglary, theft, etc. Violators of air pollution control laws are not considered to be criminals; acts resulting in air pollution, instead, require correction, so that emphasis on law enforcement here is on *compliance*, rather than punishment. Air pollution control enforcement is intended to safeguard the public health along with health, fire prevention, and industrial hygiene programs. At the same time, however, the enforcement operation must not only be tactical in the best police sense in approaching a well populated industrialized area, but must also have developed sound techniques based on a technical understanding of the air pollution problems which may occur at each of the sources of air pollution.

There are other important considerations which distinguish air pollution control field operations, a few of which are enumerated below:

1. Field control operations are intended to determine air pollution potentials and solve air pollution problems. Actual law enforcement is only one activity engaged in by those responsible for conducting field operations.
2. Field control operations assure interrelation between goal and action; between the people, the control agency, and those responsible for the sources of air pollution.
3. Field control operations also concern problems for which no legal solutions may exist and which require original legal or technical treatment. It may require various special analytical testing and research activities in many cases in order to prove a violation of a prohibition, or a public nuisance, or it may require the development of special inspection techniques.
4. Field control operations gather information and data for use by the entire control program, assure that the sources of air pollution are registered and inventoried, and answer citizens' complaints.
5. Field control operations provide certain knowledge of pollution activity through field patrol and inspection by assuring consummate, fair, and uniform enforcement of the law. Control operations assure that the laws are being continuously and simultaneously complied within the entire pollution zone.
6. Field control operations inform the managers and operators of the sources of air pollution of the laws, basic control techniques, as well as the facts of the air pollution problem.

A. *Functions of Field Control Operations*

Field control operations are called "inspection" or "inspection and enforcement" or just "enforcement," when applied to the appropriate unit of the control agency. Actually, four distinct types of operation, each of which may accomplish the intended enforcement objectives.

1. Field Patrol

This is the patrol of all areas, highways, and harbors of the pollution zone to detect all visible violations from stationary and mobile sources and to enter and to serve notices of violation where violations are observed, to maintain surveillance of all sources of air pollution, and to answer all specific source complaints made by citizens.

2. Source Inspection

This is the continual inspection of all manufacturing industrial plants and commercial establishments to determine air pollution potentials, to inventory and register the sources of air pollution, and to determine compliance or non-compliance with specific rules and regulations.

3. Investigation of Violations

This is the investigation of all alleged violations of air pollution law to determine the elements of the crime, and to gather evidence and to identify witnesses for preparation of complaint and conduct of cases to be held before the courts and the hearing board.

4. Prosecution of Violators

This involves the preparation of charges against violators, the filing of complaints in the courts, and the prosecution of violators. Petitions are also filed with the hearing board or commission or other appropriate administrative tribunal to seek revocation or suspension of permits or licenses, or other administrative action; or injunctive action is filed to restrain a person or industry from activity resulting in air pollution.

In practice, the field control operations break down into two distinct types of activity. The first is the patrol and inspection operation which is concerned directly with contacting the sources of air pollution. The result of most patrol activities and inspections are adequate in achieving compliance and cooperation. Control operations may be predominantly concerned with preventive control through persuasion by means of imparting information, appeal to civic pride, and by otherwise motivating voluntary compliance. These are most often sufficient in achieving enforcement objectives without resorting to the courts. But, it should be mentioned, the effectiveness of these techniques is often dependent upon the existence of strict laws and policies.

The second phase constitutes the investigation and prosecution of violators, and is often referred to as "legal action," or the enforcement action proper. In contrast to other techniques used in obtaining compliance, legal action is usually taken against a minority of those responsible for the sources of pollution, although, in Los Angeles County, both the number of prosecutions and the conviction ratio have been high for this type of law enforcement. In most instances, legal action is taken as a last resort, after all other means have failed.

One may say, then, that "law enforcement" in the air pollution control program pertains mostly to the *influence* of the control law in the community, and the authority it provides for the conduct of meaningful and purposeful source inspections. To establish and maintain this authority, however, legal action must be carefully and thoughtfully conducted in all cases, and especially those cases which may test new laws or facets of the control program, and which tend to create important precedents. Despite the relatively small number of cases handled, in comparison to other actions not requiring legal force, the outcome of such cases may affect the potentiality of the control program. Loss of a key case may mean the necessity of abandoning an important element of the control program. The success or failure of these cases, and all other enforcement actions, depend, then, on the accuracy and completeness of the technical data reported by all echelons of personnel involved in inspecting the sources of air pollution.

Following chapters of this manual will treat in detail the various phases of field control operations and the techniques employed in obtaining the maximum amount of useful evidence necessary to enforce the laws of air pollution. These concern the ability to apply the exact sections of the law, a practical knowledge of legal procedures employed in the prosecution of violators, the ability to identify and read visible emissions of air contaminants, determine violations, and establish public nuisance cases, and to write accurate and complete field reports.

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CHAPTER FIVE

ORGANIZATION OF THE AIR POLLUTION CONTROL AGENCY

I PRINCIPLES OF ORGANIZATION

The air pollution control program outlined in the previous chapter indicates the activities which must be implemented either by a single agency or by a number of interested agencies. These may be conducted not only by the federal, state, and local governments, but also by universities and private foundations and institutions. The responsibility for the enforcement of air pollution laws, for example, can be assumed by one of several governmental units, such as health, fire, or police departments, not to mention separately created air pollution control agencies. Permit or licensing systems, although usually a part of, or connected with, enforcement functions, may be the responsibility of health or civil engineering departments. The rulemaking authority, aside from that originating in established legislative bodies, may also be the responsibility of a specially created commission or board. Thus the control program can be instituted in any number of ways in order to best adjust to the needs and resources of any particular community.

An air pollution control "movement," working at different levels, has, in fact, been gaining momentum in the United States due to the rising demand for research, control, and enforcement. This movement has resulted in the concentration of many resources and agencies into a coordinated effort to control air pollution in recognized pollution zones. The agencies participating in this movement vary in number, size, type, purpose, and sponsorship. Of these, there are basically two types: (1) the research, information, and advisory agency, and (2) the control or enforcement agency.

The current trend in the field of air pollution is the establishment of research and advisory types of agencies on federal and state levels, and control or enforcement agencies on the local level. By placing the research responsibility with state and federal authorities, the cost of research is not only reduced substantially per capita, but a larger number of communities are directly benefited by the results.

A. *Research and Information Agencies*

1. Federal Level

At the federal level, various bureaus and departments of the United States government have made contributions toward the field of air pollution. Most notably these have been (1) the United States Public Health Service; (2) the Atomic Energy Commission, which is interested in the biological effects of radioactivity on man and life resulting from nuclear explosions; (3) the Department of Agriculture, which is concerned with the influence of air pollution on the growth of livestock and crops which might render them toxic or distasteful; and (4) the Department of Commerce, including the National Bureau of Standards, U. S. Weather Bureau, Civil Aeronautics Administration, and others.(8)

More direct action in the field of air pollution and control is taken by the United States Public Health Service under authority of Public Law 159, passed by Congress in 1955, and authorizing the federal government to:

> Support and aid technical research to devise and develop methods of abating (air pollution), and to provide federal technical services and financial aid to state and local government, air pollution control agencies, and other public and private institutions in the formulation and execution of the air pollution abatement research program.

The federal government, thus, has been playing an increasingly important role, primarily through the agency of the Public Health Service (Department of Health, Education, and Welfare), by providing the following services:

1. Research into the causes, effects (notably health and economic) and control of air pollution.
2. A national air sampling network.
3. Basic and advanced training of professional personnel for state and local governments, industry, and other institutions in the problems and techniques of air pollution control at the Robert A. Taft Sanitary Engineering Center at Cincinnati, and the preparation of manuals used in training other personnel. This agency has conducted some detailed and comprehensive surveys of community problems in such states as Connecticut, Washington, and Tennessee.

Table V - 1
LEVELS OF JURISDICTION AND TYPES OF AGENCIES

Jurisdiction	Sample Location	Type of Agency
International Treaty	Canada - U. S. Detroit - Windsor Port Huron - Sarnia	Advisory Commission
Federal	Washington, D.C. Cincinnati, Ohio	Public Law 159, Public Health Service – technical assistance, research, advisory, professional training
Interstate Compact	New York-New Jersey Interstate Sanitation Commission	Advisory
State	Delaware, Oregon New Jersey	Technical assistance, research, some enforcement
County, District, or Regional	San Francisco Bay Area, Los Angeles County	Research, enforcement, engineering
Intercity	Cincinnati and environs	Research, enforcement, engineering
City	New York City Department of Air Pollution Control	Research, enforcement, engineering on contract basis

The federal government does not, of course, directly engage in enforcement and rule-making, although it may indirectly do so through its power to regulate interstate commerce, just as it protects the public from the pollution of streams. The federal government could, therefore, regulate on the federal level those sources which the states could not themselves regulate.

2. State Level

In essential respects, the state function in air pollution control is similar to the federal, and some efforts may, in fact, be duplicated (duplication in air pollution control research is frequently useful as a means of verifying and checking the results of other agencies to provide confidence in recent findings). The state, however, tends to conduct such research programs as are specific to the area and may explore more fully the problems encountered in the individual cities. It may participate occasionally in joint action with the federal government, and in providing technical services to local communities. In addition to such services, the state, with its police powers, may provide the following: (3)

1. State-wide community air standards.
2. Emergency disaster powers, should an air pollution disaster occur.
3. Enabling legislation providing the authority for local communities to organize agencies and to enforce prohibitions, etc.
4. Participation in control development projects of pertinence to the communities in the state.
5. A state-wide sampling network.
6. Surveys estimating potential problems based on such data as population density and growth, industrial growth, fuel-use patterns and trends, topographical data, refuse disposal, etc.
7. Investigation of complaints, and public hearings.

The degree to which the state will actually participate in the administration of the control program is dependent to some degree on the size of the state, on the extent of the pollution zones, and the nature and extent of the air pollution problems. Smaller and geographically unified states such as Delaware and Massachusetts may require only a state-wide pollution authority. Large states like California, on the other hand, may be divided up into diverse geographical units and various metropolitan complexes, each requiring individual treatment.

Another feature of state participation is that it is more directly concerned with the health aspects of air pollution, since it is the responsibility of the state to protect the health and welfare of its citizens. Therefore, in many states, as in California, air pollution is the responsibility of the public health department, whereas this identification is not usually made on the local level.

B. *Control and Enforcement Agencies on the Local Level*

Most control or enforcement agencies are conducted at the local level — the city, a group of cities, a county, a district or region. The control of air pollution is essentially the function of the pollution zone itself. Whether that zone is defined by a bay, a valley, a basin, or a general area, control is best conducted by that governmental level which immediately encompasses the zone. The reasons for this are obvious. Better service is provided if the control agency is closer to the community it must serve. The community affected by the air pollution problem should decide for itself the degree to which its air pollution problem should be controlled. Local control responsibility is more adapted to applying solutions to problems which may arise, in balancing equities and in dealing with nuisances.

Generally speaking, there are two basic types of comprehensive local jurisdictions: (1) a metropolitan area composed of one city only, and (2) a metropolitan area composed of more than one and often many neighboring cities. The New York Department of Air Pollution, for example, has jurisdiction over the entire city. On the other hand, Cincinnati has employed a unique long range plan which is capable of being extended, by contract, to neighboring communities. This plan envisions cooperative activity inevitably extending to communities across the Ohio River into Kentucky.(2) In California, a district system is used because of the size of most counties in the state. These are generally inclusive of entire pollution zones, especially those counties which are becoming saturated as metropolitan areas.

Los Angeles County, for example, comprises some 71 separately incorporated cities (many of them, like Long Beach, Pasadena, Los Angeles, and Pomona, are very large in themselves), in addition to large unincorporated sections of the area. In San Francisco, the entire bay and surrounding environs constitutes one pollution zone, necessitating a six-county air pollution control district.

The control agency is thus shaped according to needs and resources. Although some aspects of agency organization may be traditional to certain communities, the control agency is organized to best cope with the nature and magnitude of the air pollution producing factors themselves: the number and kinds of sources of air pollution, the area and topography of the pollution zone (that is, the amounts and kinds of work which must be distributed to accomplish control objectives), and the cost of the program. A single important factor may be influential enough to determine an entirely unique operation. For example, the area of the pollution zone determines the amount of area coverage the field control operation must provide.

This chapter is primarily concerned with the local control or enforcement type of agency responsible

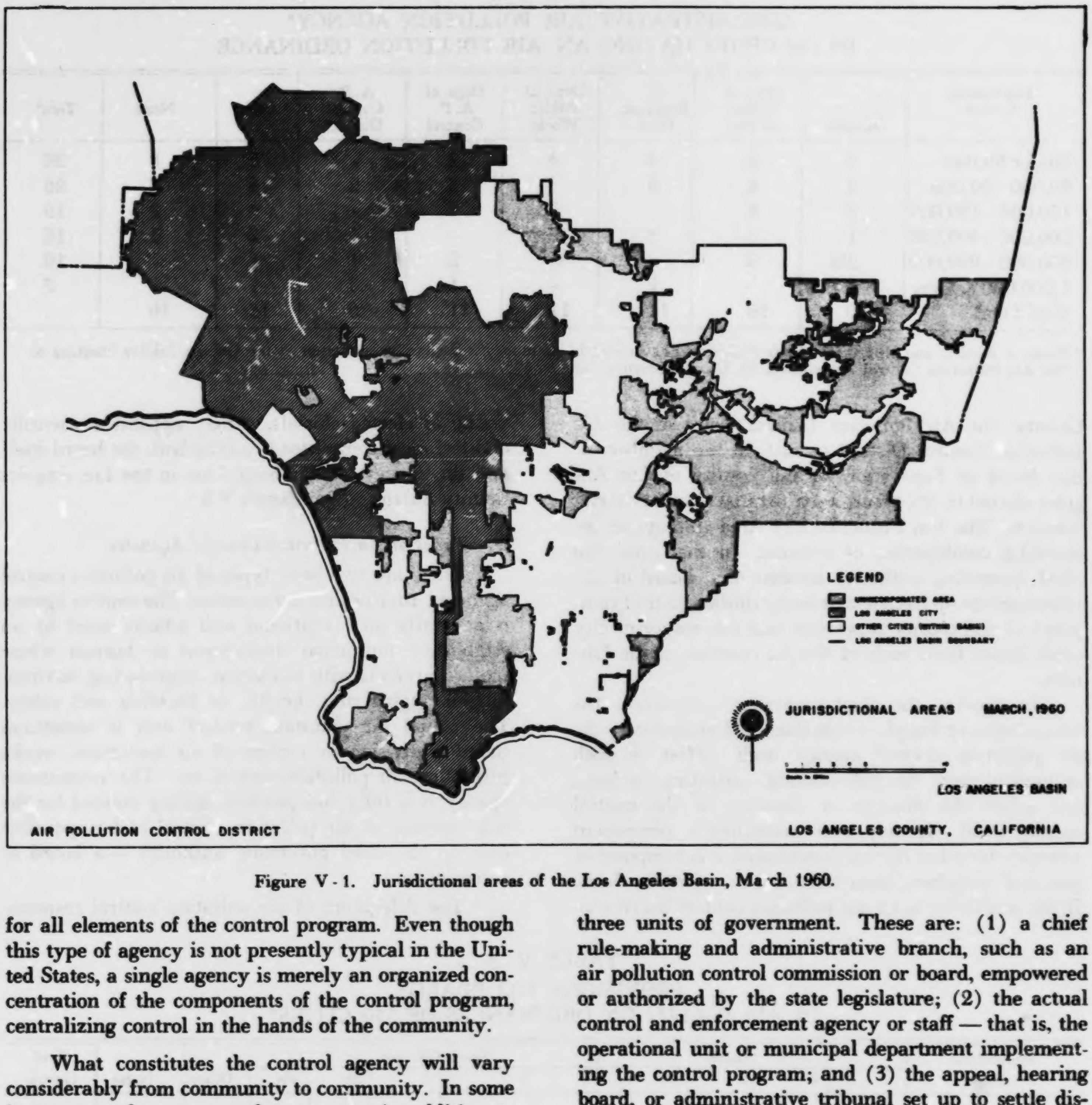

LEGEND
UNINCORPORATED AREA
LOS ANGELES CITY
OTHER CITIES (WITHIN BASIN)
LOS ANGELES BASIN BOUNDARY
JURISDICTIONAL AREAS MARCH, 1960
Scale in Miles
LOS ANGELES BASIN
AIR POLLUTION CONTROL DISTRICT
LOS ANGELES COUNTY, CALIFORNIA

Figure V - 1. Jurisdictional areas of the Los Angeles Basin, March 1960.

for all elements of the control program. Even though this type of agency is not presently typical in the United States, a single agency is merely an organized concentration of the components of the control program, centralizing control in the hands of the community.

What constitutes the control agency will vary considerably from community to community. In some instances, only one or a few persons, in addition to other duties, may be responsible for a control program. He may investigate the causes of air pollution, conduct source sampling, recommend rules, and enforce these rules as they are passed by his governing authority. In other cases, these functions will require separation and specialization, involving many personnel. Regardless of the size or type of organization, the local agency should behave as if it were guided by a coherent policy.

C. *The Chief Governing Authority — Local Agency*

In most instances, when we refer to the control *authority* we include in our frame of reference at least three units of government. These are: (1) a chief rule-making and administrative branch, such as an air pollution control commission or board, empowered or authorized by the state legislature; (2) the actual control and enforcement agency or staff — that is, the operational unit or municipal department implementing the control program; and (3) the appeal, hearing board, or administrative tribunal set up to settle disputes, and the courts themselves. This authority thus parallels the traditional separation of the legislative, executive, and judicial functions of government.

The chief governing authority is a commission, a board, a municipal department or bureau, or a combination of both. The *commission* is generally appointed by an elected official and is frequently composed of a cross section of leaders from business, industry, government, science, medicine, law, etc. Members of the commission may serve with or without compensation. The *board* is generally composed of elected representatives acting as an air pollution control board in an ex-officio capacity. In Los Angeles

TABLE V - 2
ADMINISTRATIVE AIR POLLUTION AGENCY*
IN 110 CITIES HAVING AN AIR POLLUTION ORDINANCE

Population Group	Health	Dept. of Public Safety	Building Dept.	Dept. of Public Works	Dept. of A. P. Control	A. P. Control District	Other	None	Total
Under 50,000	2	6	4	4	2	-	6	8	32
50,000 - 99,000	2	2	3	3	3	2	4	7	26
100,000 - 199,000	2	4	-	3	4	-	4	2	19
200,000 - 499,000	1	6	3	2	-	1	2	1	16
500,000 - 999,000	2½	2	1	½	2	1	1	-	10
1,000,000 & Over	1	-	1	-	1	3	1	-	7
% of Total	10	18	11	11	11	6	16	16	

* From *A Review and Appraisal of Air Pollution Legislation*, by Samuel M. Rogers, presentation at the Golden Jubilee Meeting of the Air Pollution Control Association, St. Louis, Missouri, June 4, 1957.

County, the Air Pollution Control Board of the Air Pollution Control District consists of the members of the Board of Supervisors of the County of Los Angeles elected to office from their respective supervisorial districts. The San Francisco Bay Area employs an interesting combination of systems. In that area, the chief governing authority consists of a Board of Directors made up from a six-county unified district composed of one county supervisor and one mayor or city councilman from each of the six counties of the District.

In general, the chief governing authority — the commission or board — organizes and administers the air pollution control agency itself. Most of such authorities pass on rule-making, operating budgets, and select the director or directors of the control agency itself. It may even constitute a permanent advisory function if, as a commission, it is composed of qualified members from technical or scientific fields. If the authority is an air pollution control board consisting of elected officials, it may appoint a scientific and technical committee to advise both the board itself and the agency, as has been done in the Los Angeles County district. (See Figure V-2.)

D. Types of Air Pollution Control Agencies

There are two basic types of air pollution control agencies: *captive* and *autonomous*. The captive agency is generally an operational unit administered by an established municipal department or bureau whose main concern is with sanitation, engineering, environmental engineering, health, or building and safety. The actual air pollution control unit is sometimes called a division or section of air sanitation, smoke inspection, air pollution control, etc. The autonomous agency is a fully independent agency created for the sole purpose of air pollution control and responsible only to the chief governing authority — a board or commission.

The delegation of air pollution control responsi-

TABLE V - 3
PROVISIONS FOR BOARDS
IN AIR POLLUTION ORDINANCES OF 110 CITIES*

Population Group	APC - Boards				Special Boards					Other	None	% of Group
	a	b	c	ab	a	b	c	ab	abc			
Under 50,000		1			2	3	2	1		1	22	31
50,000 - 99,000	1	2-1/2	1/2		1	6			3	1	11	58
100,000 - 199,000	1/3		1/3	2-1/2	1	5-1/3	1/2	2	1	2	4	79
200,000 - 499,000				1	2	3	1	1	1		7	56
500,000 - 999,000		1-1/2	1/2			2		2	1	1	2	80
1,000,000 & Over		1/2	2-1/3		4/5	4/5	1/2		1		1	86
TOTALS	1-1/3	5-1/2	3-2/3	3-1/2	6-4/5	20-1/10	4	6	7	5	47	

Approximately 53% of the communities provide one or more boards in accordance with ordinance requirements.

Note: a — Advisory
b — Appeal
c — Rules & Regulations

* From *A Review and Appraisal of Air Pollution Legislation*, by Samuel M. Rogers, presentation at the Golden Jubilee Meeting of the Air Pollution Control Association, St Louis, Missouri, June 4, 1957.

bility to a municipal department or bureau depends on such factors as the capacity of existing departments and bureaus to handle an air pollution control program in addition to established duties, the extent of the department's authorized powers and area of jurisdiction, etc. If only a modicum of enforcement is required, then the control function might well be placed within the jurisdiction of an existing department. If a comprehensive control program is required, which would overtax existing departments, then an autonomous agency is called for.

In some instances, the distinction between captive and autonomous is merely technical. A captive agency can have the force of a completely autonomous agency, or at least an agency that is parallel and equal to other agencies administered by the same authority. For example, a bureau of smoke control implies an equivalence to other bureaus, all of which may be administered by a department of public health or safety. In some instances, municipal government may prefer to integrate all services relating to concepts of health and welfare, rather than create a complex of independent single-purpose agencies. For example, air pollution control may be considered as a facet of public safety, public health, or environmental engineering. Even when the air pollution control program is captive, it may enforce laws and be otherwise guided by a specially created air pollution control commission, as in the case of New Jersey. In that state, an appointed commission possesses the primary rule-making authority, but air pollution control laws are enforced by the Air Sanitation Division of the Department of Health.(4)

E. Organizational Structure

Assuming that a single, comprehensive agency is required, the control agency is organized so as to (1) separate the technical functions to be performed according to the kinds and amounts of work to be accomplished *and* the professional resources available, (2) coordinate and integrate the functions of the control agency so as to make control functions meaningful and purposeful, and (3) permit flexibility in creating, modifying, or abolishing operational components as may be required from time to time.

Each element of the control program can be effected by a proper grouping of personnel into distinct operational units and subunits. The typical units of a fully developed control agency are: (1) field control operations, (2) engineering, and (3) research. The air pollution control agency, to provide for coordination of functions, will require a director and his staff, and such other administrational staffs as business management and public information and education as may be necessary. A typical organization chart based on a staff responsible to a single director is indicated below:

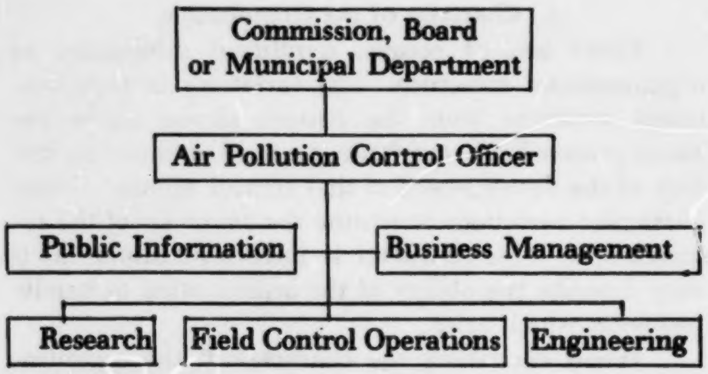


Figure V-2. Organizational pattern for a control agency responsible for administering a comprehensive air pollution control program.

1. Field Control Operations

All agencies require an organizational component devoted to the inspection of the sources of air pollution and the enforcement of air pollution control laws; i. e., field control operations. Field control operations are charged either partially or wholly with all duties connected with the pollution zone, such as the inventorying of the sources of air pollution, answering complaints, surveillance, emergencies.

2. Engineering

Because the control program requires registration of the sources of air pollution, source testing, and evaluation of all technical source data, engineering personnel will be required. If the sources of air pollution in the pollution zone are large in number, and a permit or licensing system is incorporated into the local control program, then a distinct engineering unit will be required to review plans and specifications to determine compliance with that system. Where the industrial complex of a given community is not so ramified or extensive, engineers may comprise the field inspection and enforcement operation, or be assigned to it in an advisory capacity. Where the industrial field is large and diversified, a number of approaches may be employed.

3. Research

The research unit in the organization continuously gathers data, takes air samples, forecasts pollution conditions, conducts source testing and laboratory analyses, and reduces and evaluates all data gathered by others in the organization. In a comprehensive agency, the research unit constitutes a grouping of scientific personnel devoted to the technical aspects of air pollution and its control.

The organization of a fully developed control agency is partially based on permanent control functions, partially on a project basis — since the agency may tend to mobilize around a concerted effort to solve one or more major problems at a time. Because of this fact, a control agency may grow to accommodate a need in, say, its research function and when projects are completed and translated into law, that function may cease.

4. Character of the Organization

There are, of course, significant differences in organizational structure. The variations in organizational structure from the pattern shown above are based primarily on emphasis, on need, and on the history of the development of that control agency. These particular variations constitute the *character* of the organization. This character is important insofar as it may describe the ability of the organization to handle problems which arise.

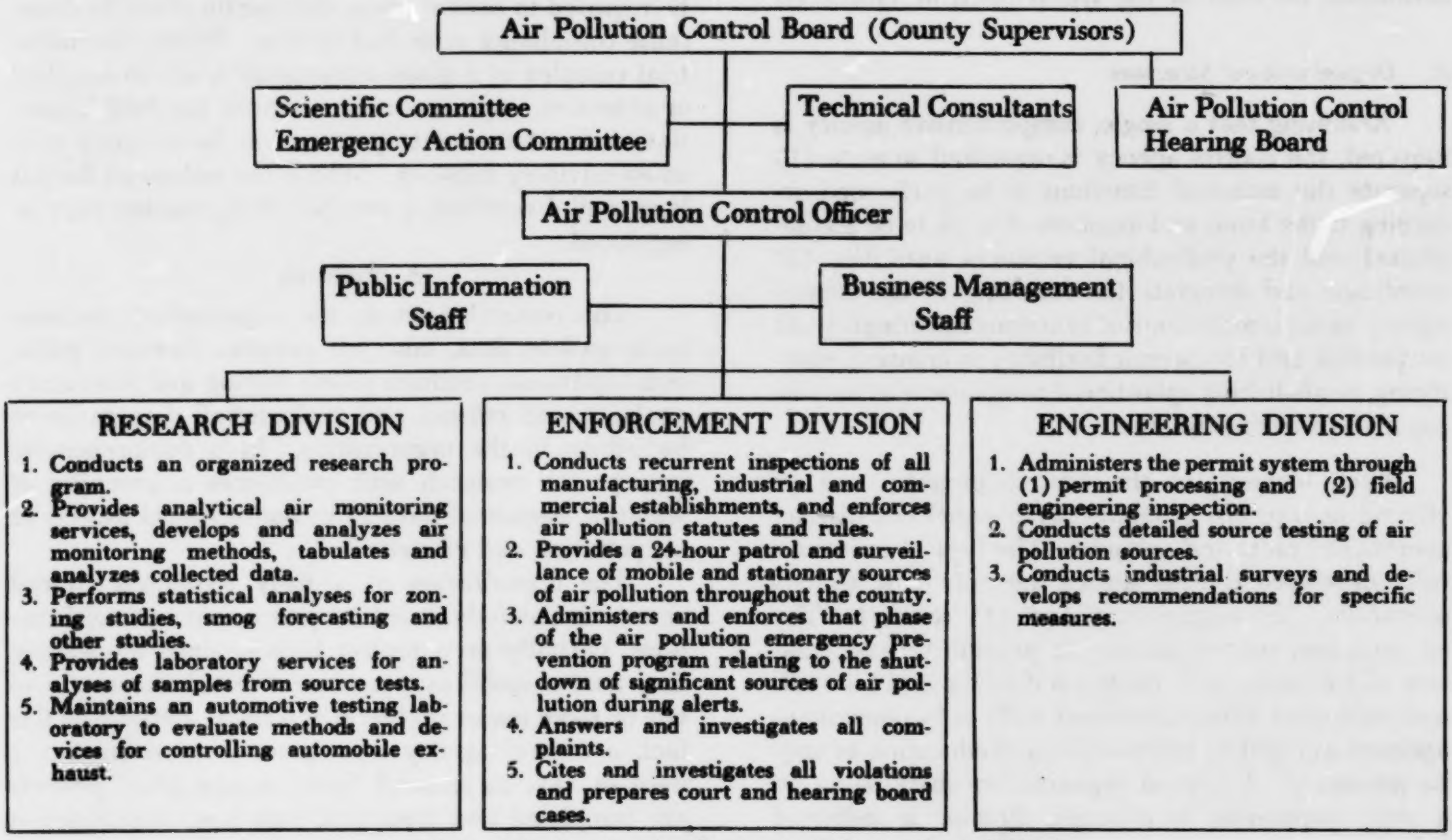
When describing the character of the organization, we may speak about the emphasis taken in the administration, which may either be the philosophy of a professional element dominating the organization, or an emphasis which is tactical in coping with problems. There is no question that certain control philosophies tend to be unique to certain professions. A research scientist may exert a mood of overcaution on the entire program by virtue of his need for exhaustive information on any subject. A professional enforcement officer may feel the necessity for strong and uncompromising enforcement. On the other hand, technical personnel may feel that solutions may be obtained through mass technological change, unmindful, perhaps, of the real and practical problems which are current in the field and which can be solved by immediate enforcement action. Public relations personnel may feel that real control is accomplished by dealing directly with public opinion to motivate compliance. There is no one "true" character a control agency should assume. Organizations vary from community to community according to local requirements. What is important is that the agency be capable of responding to problems which arise.

Sometimes, where a large number of tasks and disciplines are required to accomplish objectives, it is advantageous for the control agency to be administered by those skilled in public administration in order to provide for a balanced and coordinated program. Professional administration obviates those administrative tasks which interfere with the technical concerns of various functions. The individual divisions of the organization, however, will be administered in terms of the most qualified personnel in the fields directly involved, each representing a corps of experts as shown in Figure V-2. At the same time, leadership provided by the administrative unit expands, contracts, or shifts the resources of the agency to fit the needs of the problem.

II ORGANIZATION OF THE LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT

The activities of the Los Angeles County Air Pollution Control District are basically organized to provide for separation, specialization, and coordination of functions. The basic operational divisions, as shown in Figure V-3, are Enforcement, Engineering, and Research, supported by such administrative staffs as Business Management and Public Information and Education.

The important characteristic of the Air Pollution Control District in Los Angeles County is that each division is vested with a large degree of independence,


Air Pollution Control Board (County Supervisors)
Scientific Committee
Emergency Action Committee
Technical Consultants
Air Pollution Control Hearing Board
Air Pollution Control Officer
Public Information Staff
Business Management Staff
RESEARCH DIVISION
ENFORCEMENT DIVISION
ENGINEERING DIVISION

RESEARCH DIVISION

1. Conducts an organized research program.
2. Provides analytical air monitoring services, develops and analyzes air monitoring methods, tabulates and analyzes collected data.
3. Performs statistical analyses for zoning studies, smog forecasting and other studies.
4. Provides laboratory services for analyses of samples from source tests.
5. Maintains an automotive testing laboratory to evaluate methods and devices for controlling automobile exhaust.

ENFORCEMENT DIVISION

1. Conducts recurrent inspections of all manufacturing, industrial and commercial establishments, and enforces air pollution statutes and rules.
2. Provides a 24-hour patrol and surveillance of mobile and stationary sources of air pollution throughout the county.
3. Administers and enforces that phase of the air pollution emergency prevention program relating to the shutdown of significant sources of air pollution during alerts.
4. Answers and investigates all complaints.
5. Cites and investigates all violations and prepares court and hearing board cases.

ENGINEERING DIVISION

1. Administers the permit system through (1) permit processing and (2) field engineering inspection.
2. Conducts detailed source testing of air pollution sources.
3. Conducts industrial surveys and develops recommendations for specific measures.

Figure V - 3. Functional organization chart of the Los Angeles County Air Pollution Control District.

and is administered by a director selected for his skill, knowledge, and experience in the field. Each division, except for the supporting staff functions, represents a fully developed organization capable of existing in its own right. The directors of the various divisions, as well as the heads of the staffs, form the executive staff of the Air Pollution Control Officer.

Since the District was organized in 1948, it has undergone successive internal reorganizations, periodically shifting activity emphases to achieve what might be called a "balanced" control; i. e., coordination of the operating divisions so that the entire organization could operate in concert and with the emphasis as may be required at any given time.

In considering the organizational structure of the Air Pollution Control District, it is important to note that the District is not only charged with the responsibility of implementing the industrial source control, enforcement, and research programs as discussed in Chapter 4, but also with the responsibility of handling virtually any type of emergency which might arise. These additional responsibilities include:

1. Emergencies resulting from unusual rises in concentrations of chemical contaminants as defined in Regulation VII (see Chapter 3).
2. Emergencies arising from hazardous increases in radioactive contaminants.

These responsibilities are integrated into the control organization. Under Los Angeles County Ordinance 5582, the District has been declared the Radiological Defense and Disaster Service of the Civil Defense Authority. As such, both activities involve planning, forecasting, and monitoring. Emergencies resulting from smog-forming contaminants are the responsibility of established components throughout the District (Regulation VII). The Radiological Disaster Service, while involving air monitoring, is primarily concerned with coordinating local responsibilities and personnel training, in order to prepare for disaster arising from nuclear war.

A. Engineering Division

The functional diagram of the Air Pollution Control District as shown in Figure V-3 is self-explanatory. As will be noted, enforcement and engineering functions are separated. The separation, rather than the consolidation of the divisions, has long been established in Los Angeles County, though they are in many specific instances coordinated to accomplish a given objective. In Los Angeles, the Rules and Regulations require competent review of plans, applications, and specifications in addition to engineering field inspection before permits can be issued, necessitating review by personnel expert in the various engineering fields such as combustion, metallurgy, chemical processing, petroleum, etc., as well as source testing and control development. Since the Los Angeles area is fully represented by almost all types of industry, the engineering talent necessary to process permit applications for this industrial economy must be equally extensive and diverse.

B. Enforcement Division

Because of the more than 1200 square miles which must be patrolled by the enforcement operation, and the amount of attention required by the numerous sources of air pollution, it is impractical for enforcement personnel to spend office time in engineering review of permit applications. Furthermore, the degree of compliance in the field and the engineering standards which must be met by equipment are so high that specialization on the part of inspectors and engineers, respectively, is mandatory. Therefore, in the Los Angeles County Air Pollution Control District, the enforcement and engineering divisions are permanently maintained, with personnel strength based on field-load requirements.

C. Research Division

The Research Division, on the other hand, is not entirely within the concept of local government, organizationally speaking. Research can be contracted for, or performed on a state or federal level. In the absence of concerted research at any level, however, it was first necessary in Los Angeles to determine what contaminants must be controlled, and how. The research function is more variable than any of the other control functions, and falls into two categories: (1) self-terminating projects, and (2) permanent activities, such as source sampling and air monitoring.

In the Air Pollution Control District, the advance on the unknowns of the air pollution problems has had the effect of shifting the research emphasis from the causes and effects of air pollution to the resolution of immediate ground source problems, such as auto exhaust and organic solvents. The phenomenal effects of the various types and quantities of air contaminants, together with their meteorological variables, have become sufficiently understood for control development purposes. Once particular projects are completed toward realizing goals, they are terminated. Some of these may result in permanent control functions on other operational levels, others may not.

To conclude, the uniqueness of the Los Angeles County Air Pollution Control District resides in the fact that it is a balanced, coordinated agency, fully encompassing all elements of the control program. As such, it represents a primary jurisdiction in the 4000 square mile area of Los Angeles County. Thus, the Los Angeles County Air Pollution Control District, with its hearing board, consultants, scientific and emergency action committees, and the completeness of its control and enforcement organization, represents an amalgamation of many resources into one district-wide task force.

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CHAPTER SIX

AIR POLLUTION CONTROL FIELD OPERATIONS

I PRELIMINARY CONSIDERATIONS

Air Pollution Control Field Operations are those activities conducted by a control agency to secure continuous control of the sources of air pollution in the pollution zone. The nature of this activity varies with the specific laws and policies of control agencies. In some agencies, field control operations are of an advisory and data-gathering nature; in others, they are confined to law enforcement activities. In this chapter we shall be concerned with a severe air pollution problem in which both the laws enforced and the enforcement policy are intended to obtain a mass reduction of all pollution potentials, the highest rate of mass-compliance possible and an alert emergency-response capability. To achieve these goals, field control operations must provide for two distinct activities — *source inspection* and *law enforcement*.

Source inspection includes all of the activities conducted by the control agency to attain minimum pollution potentials and to gather information. These include:

1. Continuous and simultaneous surveillance of all source areas of the pollution zone.
2. Detection and location of the sources of air pollution.
3. Inspection and inventory of stationary source production and control equipment to secure compliance and to assess air pollution potentials.
4. Rapid response to air pollution hazards and emergencies whenever and wherever they arise.
5. Resolution of unique pollution problems through application of special legal, technical and engineering skills.

Law enforcement is the detection, investigation and prosecution of the violators of the air pollution control laws. The primary concern of enforcement is to attain the highest degree of compliance possible. Air pollution law enforcement, therefore, concentrates on those provisions and prohibitions of the legal authority which are intended to regulate the sources of air pollution. For example, of the numerous provisions in the California State Health and Safety Code, the Rules and Regulations of the Los Angeles County Air Pollution Control District, and Section 27153 of the California Motor Vehicle Code, the Enforcement Division of the A.P.C.D. enforces primarily those prohibitions shown in Table III-2. All other legal provisions are handled administratively by the Air Pollution Control District as a whole.

Although the two types of activities are embodied in the same function — i. e., field control operations — only a relatively small minority of the sources of air pollution inspected in an established program result in direct legal action. The inspection phase of the field control activity, therefore, will assume major emphasis, not only because of its influence in achieving voluntary control, but in the information it supplies the control agency.

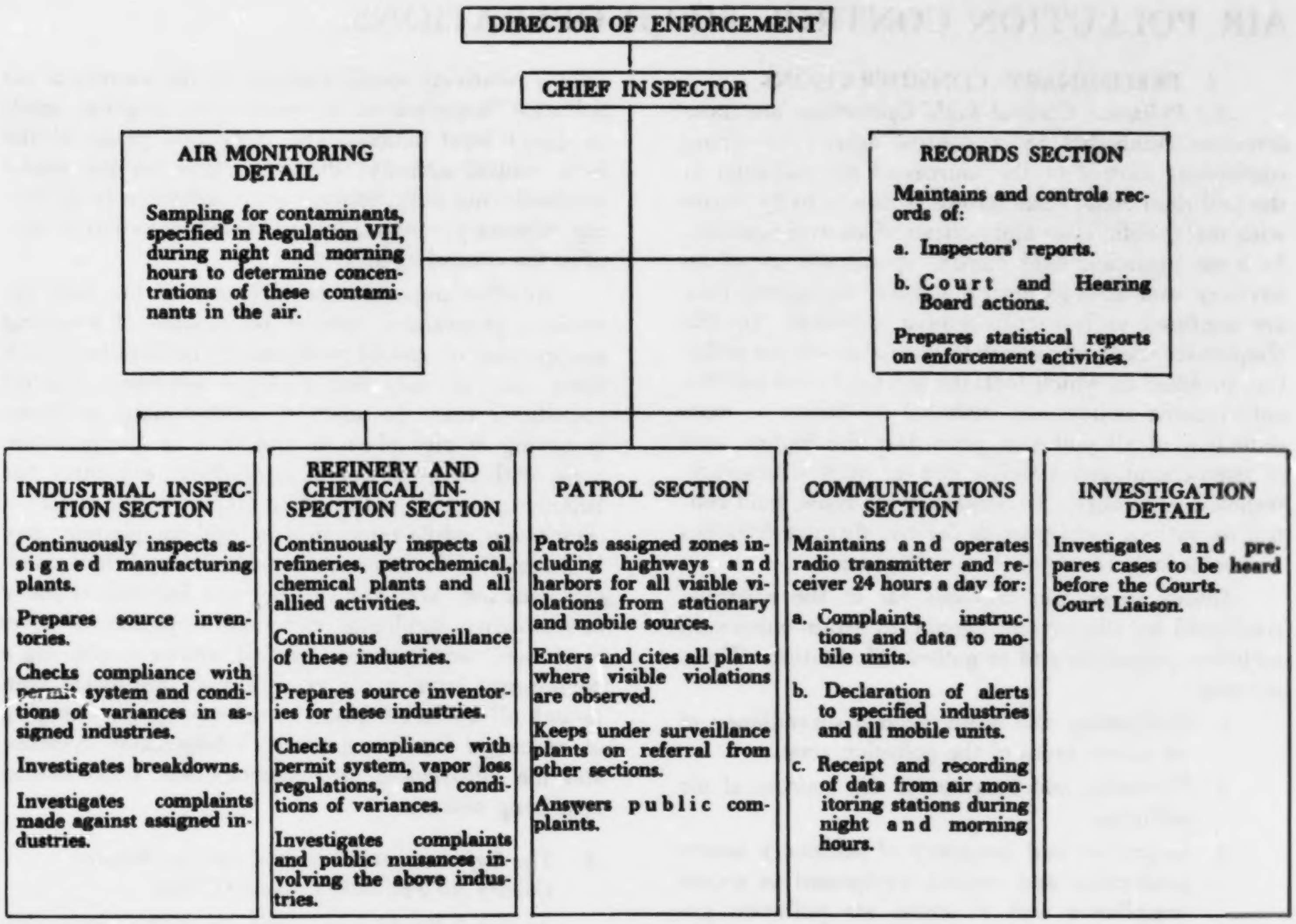
Another important requirement of the field operations program is that it be capable of handling emergencies or special problems in the field for which there may or may not be legal solutions. Control operations must be alert to contaminant problems occurring at any place or any time in the pollution zone, without prior notice, and which may upset the balance in actual pollution levels, or whose contaminant levels, while remaining in legal compliance, may be intensified by adverse atmospheric conditions. Such problems are: accidental equipment failures; refinery breakdowns; accidental emission of poisonous gases or fumes; accumulation of air contaminants in a community from a concentration of industries, even though all are in compliance; the emergency dumping of ammonia from commercial refrigeration systems; and the diffusion of an obnoxious odor from animal rendering sources.

A. *The Enforcement Division of the Los Angeles County Air Pollution Control District*

In the A.P.C.D. practically all of the responsibility for conducting field operations and law enforcement is vested in the Enforcement Division. The organization of the Enforcement Division (Figure VI-1) takes into account assigned functions in law enforcement and technical duties associated with source inspection. Since the former reflects a firm policy of the control program, the organization of the Enforcement Division in some respects resembles the chain-of-command system employed by typical police departments. The discipline exerted, however, is not intended to regiment for the sake of military efficiency, but to maintain an alertness to field conditions and to obtain a maximum degree of valid evidence for each legal action which may be undertaken.

The activities of the Enforcement Division are administered by a Director of Enforcement and supervision is accomplished by a Chief Engineering Inspector with the assistance of three Head Engineering Inspectors. Field operating personnel consist of Air Pollution Inspectors, Air Pollution Engineering Inspectors and Senior Air Pollution Engineering Inspectors (field supervisors).

In order to facilitate field operations and to consolidate activities on a functional basis, personnel are assigned to three major field operations groups, two



DIRECTOR OF ENFORCEMENT

CHIEF INSPECTOR

AIR MONITORING DETAIL

Sampling for contaminants, specified in Regulation VII, during night and morning hours to determine concentrations of these contaminants in the air.

RECORDS SECTION

Maintains and controls records of:

a. Inspectors' reports.

b. Court and Hearing Board actions.

Prepares statistical reports on enforcement activities.

INDUSTRIAL INSPECTION SECTION

Continuously inspects assigned manufacturing plants.

Prepares source inventories.

Checks compliance with permit system and conditions of variances in assigned industries.

Investigates breakdowns.

Investigates complaints made against assigned industries.

REFINERY AND CHEMICAL INSPECTION SECTION

Continuously inspects oil refineries, petrochemical, chemical plants and all allied activities.

Continuous surveillance of these industries.

Prepares source inventories for these industries.

Checks compliance with permit system, vapor loss regulations, and conditions of variances.

Investigates complaints and public nuisances involving the above industries.

PATROL SECTION

Patrols assigned zones including highways and harbors for all visible violations from stationary and mobile sources.

Enters and cites all plants where visible violations are observed.

Keeps under surveillance plants on referral from other sections.

Answers public complaints.

COMMUNICATIONS SECTION

Maintains and operates radio transmitter and receiver 24 hours a day for:

a. Complaints, instructions and data to mobile units.

b. Declaration of alerts to specified industries and all mobile units.

c. Receipt and recording of data from air monitoring stations during night and morning hours.

INVESTIGATION DETAIL

Investigates and prepares cases to be heard before the Courts. Court Liaison.

Figure VI - 1. Functional organization chart of the Enforcement Division of the Los Angeles County A.P.C.D.

service groups and two special details. The field operations groups are known as the Uniformed Patrol Section, the Industrial Inspection Section and the Refinery-Chemical Section. The service groups are the Communications Section and the Records Sections. The Air Monitoring Detail, recruited from the field force on a rotation basis, operates eight air monitoring stations during night and early morning hours, in addition to maintaining overall surveillance of industrial activities during these hours. The Investigation Detail, which is assigned to court case preparation and presentation, is assigned to a member of the Records Section, or to any other enforcement personnel with investigative experience.

1. Field Operations Groups

Because of the diversity of the many industrial, domestic and commercial sources of air pollution, the geographical distribution of these sources and the various air pollution and enforcement problems which arise, two general approaches to the deployment of field personnel are necessitated by the A.P.C.D. These may be summarized as: (1) geographical deployment of inspectors by sectors, and (2) assignment of field personnel to various categories of complex industries, or unique air pollution problems. The grouping of personnel in the Enforcement Division takes into account both needs simultaneously. All enforcement sections in the Division are delimited by geographical areas, yet all assume some specialized assignments.

2. The Service Groups

In an enforcement agency, the service groups are primarily concerned with the transmission of information to and from field inspectors and headquarters personnel, the recordation and filing of information, the rendering of dispositions to reports and the initiation of some field assignments. In the Enforcement Division, the service groups consist of two headquarters-based sections: (1) the Communications Section which, by means of radio and telephone communications, serves to continuously and instantaneously dispatch, locate and coordinate all mobile field units; and (2) the Records Section, whose responsibility it is to compile case histories and enforcement statistics, provide a basis for controlling work-loads and assignments, maintain continuity of enforcement actions, provide selective analyses to data for evaluation of specific field operations programs, and other important functions.

3. Administration of Work Assignments

Because of the number of variables which must be subject to administrative control in any field operations program conducted in a metropolitan economy as large and diverse as Los Angeles County, planning of an effective enforcement program must provide for optimum use of all available personnel. The object of planning is to deploy personnel in such a manner that inspectors' reports, violation notices and citations issued represent as much as possible true conditions of compliance or non-compliance. At the same time, it is important that industries having specific air pollution problems receive necessary attention, that equal amounts of work-loads be divided among any given category of inspector, that the correct number of personnel be employed to provide both saturation and selective coverage, and that all activities and the sources of air pollution be easily located and assigned.

II DETECTION OF THE SOURCES OF AIR POLLUTION

The first task of field control operations is to locate and identify the sources of air pollution and the problems which require solution. The sources of air pollution are detected through patrol surveillance, systematic equipment inspection and registration, and investigation of citizens' complaints. Each source of air pollution must be observed by a responsible member of the control agency, and the stack emissions and the equipment and operational procedures employed must be noted.

To accomplish the observation and inspection of each source of air pollution in the pollution zone, field control operations must provide adequate coverage of the pollution zone in the shortest possible time without compromising quality or justice. This, of course, must be accomplished within budgetary restrictions and with a limited number of inspection personnel. Initially, the control agency must choose between either one or a combination of *saturation* or *selective coverage* techniques.

Saturation coverage is intended to obtain a minimum pollution potential (see Chapter 1 for definition) through securing the greatest degree of mass-compliance with the statutory authority possible. Saturation coverage, therefore, provides for (1) uniform and complete inspection of *all* potential sources of air pollution, (2) continuous status determination of compliance as well as non-compliance, and (3) a degree of surveillance and inspection capable of detecting the critical number of violations which may occur at any time.

Selective coverage, on the other hand, is concerned only with the investigation and solution of certain key and isolated problems.

Obviously, the more field personnel employed by the control agency, the greater the coverage that can be provided. Since all control operations are limited by budgetary considerations, optimum, rather than maximum, coverage is sought. Field deployment, therefore, must be based on two considerations:

1. *Surveillance Factor*. The period of time and the frequency each source of pollution is to be observed.
2. *Inspection Factor*. The frequency with which each piece of equipment is inventoried for source registration and inspected thoroughly to determine compliance with the air pollution control law.

Surveillance consists of observing both specific industrial plants and whole source areas at a time within the radius of vision of a patrol inspector. Given a surveillance factor, the chance of observing recurrent visible violations increases with the fraction of the time during which the plant is under observation, provided that the observation period is randomized with time. For example, supposing that the surveillance factor for each industrial plant in a sector is one hour during each eight-hour day, the probability of observing instantaneous violations in a sector during an eight-hour period is one in eight; but the chance that any instantaneous violation will escape detection in 20 violations is one in sixteen. Therefore, with appropriate deployment of patrol inspectors, all recurring violations can be detected within a reasonable period of time. A sector whose area enables a patrol inspector to detect all recurring violations within about 30 working days may be considered as providing saturation coverage. This time period should be long enough to allow for the detection of random visible violations and other duties which may be performed by the patrol inspector. The smaller the patrol sector, the sooner this can be accomplished.

To maximize the surveillance factor, the patrol inspector should be trained to patrol in a manner that will bring the greatest area of his sector under view while taking the shortest route. Each location should be patrolled at different times each day, maximum use should be made of vantage points, and streets should be patrolled which are central to the area under view. As the patrol inspector becomes familiar with his sector, his patrol activity tends to concentrate in the areas of highest source density.

The *inspection factor* is predicated on the changes which may take place in industrial equipment and operations. Since equipment and operation do not change rapidly, a common practice is to provide for at least one inspection of each source of air pollution annually. This is based on an equipment and business turnover that tends to be realized at the end of each fiscal cycle or year. (See Chapter 14.)

Sources of air pollution are not only detected through patrol and source inspection, but also by citizen complaints and aerial inspection. The fact that

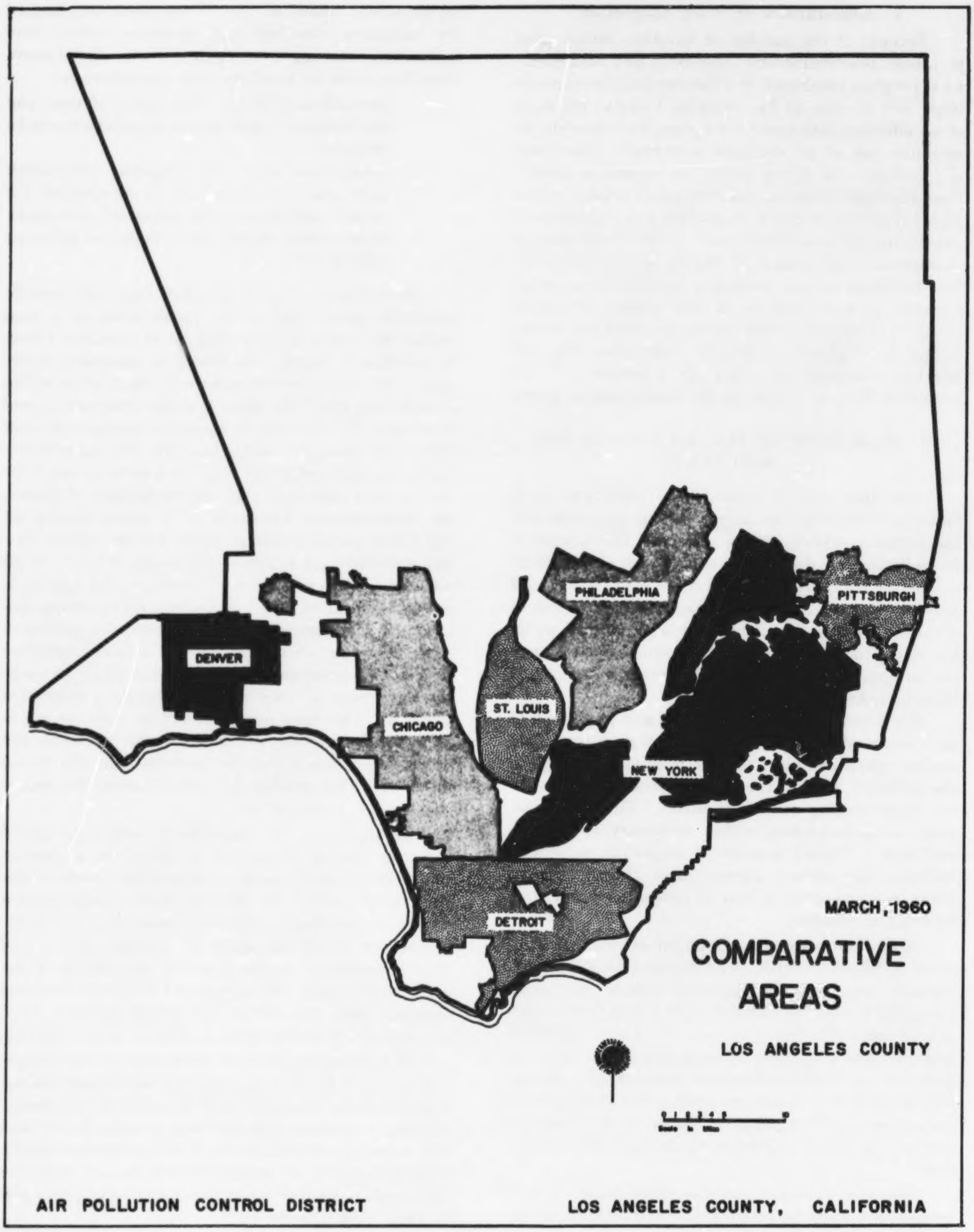


Figure VI - 2. Comparative size of the Los Angeles County Air Pollution Control District and other major Air Pollution Control agencies.

citizens complain of outstanding visible emissions, malodors and contaminant deposits extends the total surveillance factor considerably.

A field control operation just beginning will have more work than it can complete in terms of handling all visible violations observed. Nevertheless, field inspectors must be deployed systematically in the field so that all sources of equal importance are equally observed. Initial planning criteria include (1) the size of the control area and the possible inspection sectors based on the above consideration; (2) the number, types and importance of the sources of air pollution; (3) the location and distribution of industrial and commercial establishments and residential areas; and (4) other factors such as major freeways and highway routes, number of incorporated cities in the area, areas of heavy vehicular traffic, important geographical barriers.

A. Deployment of Field Inspectors in Los Angeles County

The Los Angeles County Air Pollution Control District maintains control jurisdiction over the entire land area of Los Angeles County comprising 4,083 square miles and 71 separately incorporated cities. This area is geographically divided by the mountain chain into two sections. The southern section, the coastal plain, is the Los Angeles County Basin, which includes virtually the entire metropolitan area of Los Angeles County — some 5,000,000 people spread over a 1200 square mile area. The second section is the sparsely populated desert areas north of the mountainous regions.

Since both the smog problem and the sources of air pollution are concentrated within the metropolitan area, the major enforcement effort is conducted in the Los Angeles Basin. All laws and regulations, with the exception of Regulation VII (Emergencies) and bans on rubbish burning (Rules 57 and 58), however, apply to all stationary and moving sources in all 4,083 square miles of the county area.

Both sections of the control jurisdiction represent an unusually large area to be covered by an enforcement agency. The field of operations, in fact, is larger for the A.P.C.D. than it is for any other local law enforcement agency under a single command in Los Angeles County, and it is one of the largest in the nation patrolled by a single air pollution control agency.

Although industrial decentralization is the general pattern of development in Los Angeles County, various types of source areas are differentiated by special air pollution problems. These are:

1. Central Manufacturing Industrial area —including eastern portions of downtown Los Angeles, Vernon, Bell, Maywood, Huntington Park, and South Gate. These consist of varied industrial manufacturing plants.
2. Southern sections of the basin — these include virtually the entire southern strip — El Segundo, Torrance, Dominguez, North Long Beach, Long Beach, containing some 10,000 oil wells and 5,000 crude oil tanks. major refineries, tank farms, petrochemical and chemical plants and nearly all aircraft and secondary air frames industries.
3. The harbor and coastal areas — these include all ports, shipping offices, harbors, naval stations, fish canneries and steam generating plants.
4. The west-central metropolitan area — includes most congested areas of vehicular traffic, apartment house dwellings which, prior to incinerator bans, constituted a significant source of smoke, and a correspondingly high complaint load area.
5. The downtown Los Angeles area — includes office buildings, government buildings, department stores and textile lofts providing the greatest concentration area-wise of boilers.
6. The cities — include relatively large incorporated cities such as Pasadena, Glendale, Long Beach, and Burbank, and community developments such as the San Fernando Valley, each having an industrial community.
7. Exterior outbound and inbound traffic areas — these include arterial highways, the major trucking routes for diesel tractors and trailers.
8. Agricultural areas — include peripheral portions of the county in which agricultural burning may be conducted, or agricultural areas burned and cleared for tract developments; also dumps, hog ranches, asphalt batching plants, concrete batching plants and other dusty or malodorous industries.

The sources of air pollution to be inspected consist of a total of approximately 16,000 industrial and commercial establishments and all local, state and federal governmental facilities containing sources of air pollution.* This potential includes, in the southern part of the county, 19 major and independent oil refining industries with a total throughput capacity of crude oil of about 730,000 barrels per day, and a finished gasoline product of about 16 million gallons per day. The area is also served by 11 oil-fuel burning power plants with a capacity of 14,000,000,000 kilowatt hours. Mass sources also include about 3,000,000 motor vehicles, including trucks and buses which must be observed for smoke pollution. A breakdown of the major air pollution potentials, as of March 1959, follows:

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* L.A. Co. A.P.C.D., Activity Location Maps, March, 1959.

Asphalt Paving "Hot Plants"	34
Asphalt Saturators	11
Brass Foundries	97
Cast Steel Foundries	25
Galvanizing and Tinning Plants	23
Grey Iron Foundries	45
Meat and Fish Smoking Plants	44
Paint Manufacturing Facilities	25
Petrochemical Plants	13
Public and Privately Owned Power Plants	11
Refineries	19
Rendering Facilities	26
Secondary Metal Melting Plants	49
Tire Manufacturing Plants	5

These represent major potentials whose compliance is assured through field control operations. Other air pollution potentials resulting from such sources as auto exhaust and organic solvents may be subject to control pending completion of research projects and passage of control legislation.

In addition to the major sources of air pollution, other industries requiring less attention as a whole must still be inspected. These include such industries as aircraft and automobile assembly plants, metal fabricating plants, woodworking plants, aluminum foundries and other non-ferrous industries other than aluminum or brass, bulk loading and marine refueling stations, grain and feed mills, totalling together with the major sources, but exclusive of commercial establishments, some 5,000 plants. Although such plants may not present large contributions to the total air pollution problem, they may cause local nuisances.

In order to overcome problems presented by this diversity and complexity of the sources and the magnitude of the land area, it is necessary to make inspection assignments according to the following:

Sector patrol and inspection
Scheduled inspection
Specialized enforcement
Citizens' reports
Aerial inspection

1. Sector Patrol and Inspection

The decision to employ a geographical sector system is determined by the fact that individual inspectors must operate over a limited land area in order to locate, observe thoroughly and inspect a certain number of plants. The sector system is useful in dividing up equal amounts of work loads among any given category of field inspector, assures that plants of equal importance receive equal attention, and provides a system whereby all of the field responsibilities, activities and the sources of air pollution may be easily located and assigned.

The size of a sector is based on the number of man-hours the sector required to perform the essential routine inspections in the sector. A sector with a lower source density will be larger in area than one which is highly concentrated.

The first determination of the size of the sector is usually made experimentally since the time it takes to inspect the actual number of equipment units is undetermined. The first sector boundaries may be established from rough estimates of source densities and locations compiled from Chamber of Commerce statistics, telephone directories, preliminary surveys, etc. After inspectors have been assigned to the sectors, the amount of time required to perform the various field inspections is ascertained. Time factor units may then be averaged for each significant source of air pollution in the sector and situated on a map of the pollution zone. The sector boundaries may then be adjusted to provide areas of equal work loads in terms of man-hours while compensating for such factors as travel time, accessibility of sources. The sector division, of course, can never be perfectly accurate, but it can be used to correct outstanding discrepancies resulting from previous procedures.

In Los Angeles County, sectors are weighted by the time necessary to conduct an inventory inspection of each piece of equipment in the sector. One-half of approximately 2,000 man-hours per year available for each sector are allocated to inventory inspections, and the remainder to other duties.

The inspection sector which results then represents that amount of work an inspector can complete in a year.

a. Patrol and Engineering Inspectors

In Los Angeles County, a Patrol Inspector and an Engineering Inspector are assigned to each sector, under separate supervision. The Patrol Inspector is concerned with the activity of the sector as a whole, the Engineering Inspector with each industrial plant in the sector.

The Patrol Inspector thoroughly and systematically patrols the sector for all visible violations which may issue from stationary and vehicular sources of air pollution. He answers all complaints dispatched to him and provides whatever other field assistance may be requested by other inspection personnel in his sector. The important characteristic of the Patrol Inspector is his mobility, unencumbered by the paper work that must accompany more technical inspections thus promoting a higher degree of ground coverage. The patrol coverage enables a reasonable percentage of the control jurisdiction to be kept under continuous observation each day. Another benefit is also conferred by the activity of the Patrol Inspector. Since he is uniformed and patrols in a clearly marked black and white emergency vehicle he poses a definite visible deterrent to negligent operation of equipment by

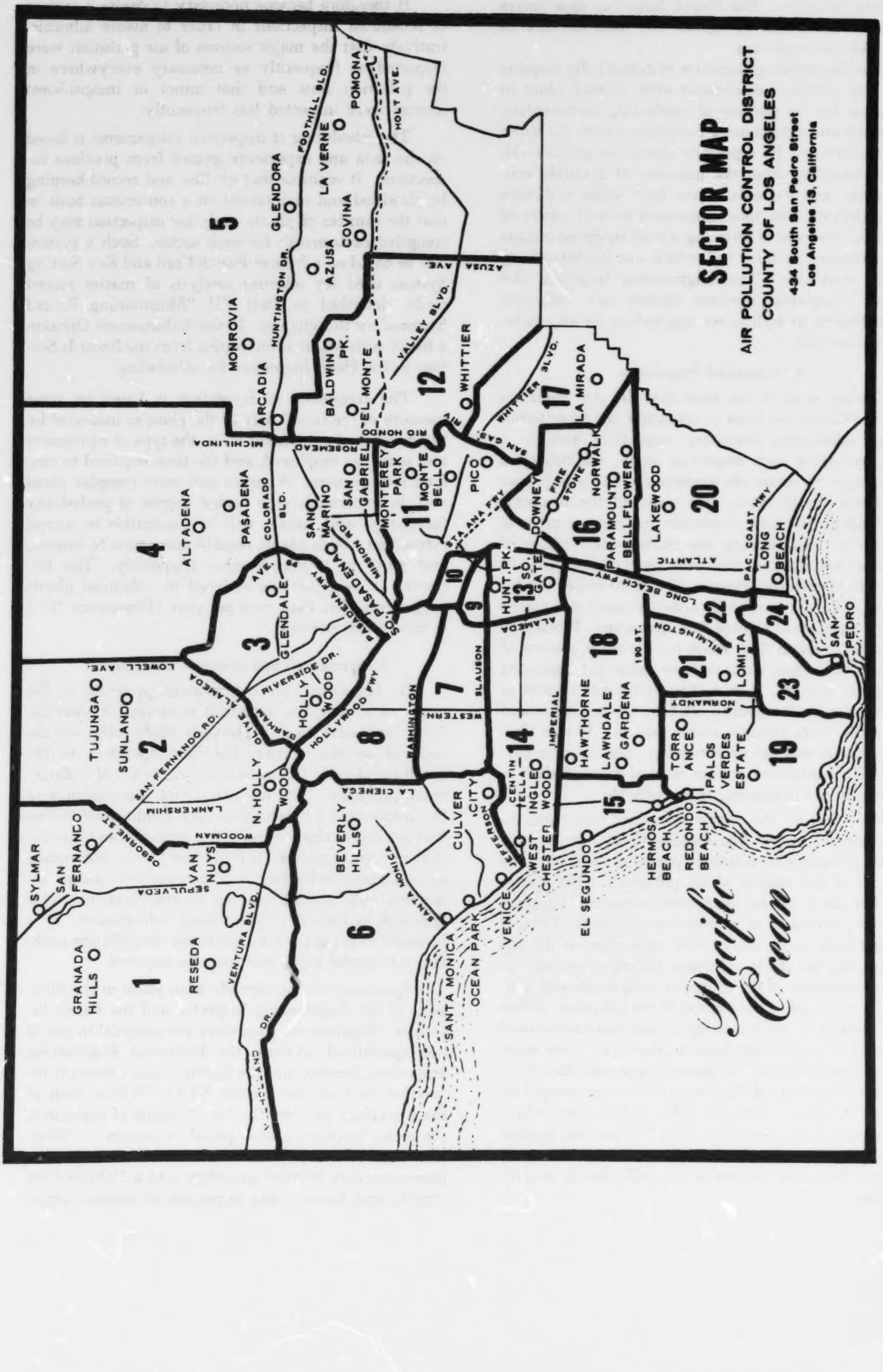

Figure VI-3. Sector map of Los Angeles County used for geographical deployment of enforcement personnel.

would-be violators. The Patrol Inspector thus serves as a first-line of defense against any mass emission of visible air contaminants.

The Engineering Inspector systematically inspects all of the pertinent equipment units in each plant in the sector for the purpose of conducting an inventory inspection and determining compliance with the Rules and Regulations. He especially checks for possible violations resulting from the emission of invisible contaminants, and requests source tests when violations are suspected. The most important overall aspect of his work, however, is ferreting out all equipment units which require permits and which are inadequate by current standards. The Engineering Inspector also handles complaints directed against any industrial establishment, as well as serving notices for any violation he observes.

2. Scheduled Inspections

During most of the time that the Air Pollution Control District has been in operation, the responsibility for scheduling inventory inspections and, in a sense, managing each inspection sector, was delegated to the inspector under the assumption that with proper experience, qualification and training, the inspector would adopt effective inspection methods suitable to each sector. Considering the inadequate number of personnel employed in the early years of the District's operation (variously between 12 and 20 inspectors for the entire 4,000 square mile area) reliance was placed on the judgment of trained field inspectors. It could be said of this system that, while not all of the sources of air pollution were contacted, or were not contacted frequently enough, most of the significant sources of air pollution in the county, such as the foundries and steel mills, were brought under control. At that time the emphasis was not on saturation, but selective coverage. This initiative system worked most effectively in terms of the manpower then available.

However, as the major offenders were brought under control, and as Los Angeles County grew, even greater reduction in pollution potentials was required from *all* of the sources of air pollution. This system thus fell short of the aggressive inspection program outlined previously in at least two respects. First, it was not able to assure certain inspection of all significant sources of air pollution, failing to provide accurate knowledge of the degree of compliance and noncompliance at all of the sources of air pollution. Inferences cannot be as accurately drawn from infrequent observations and inspections as they can from more frequent surveillance. It became apparent that there was one frequency of inspection which encouraged an operator to take calculated risks, and another which discouraged him. Secondly, not all inspectors applied the same methods and techniques, and not all would evaluate the same sources of air pollution in exactly the same way.

It therefore became necessary to devise a system of scheduled inspections in order to assure administratively that the major sources of air pollution were inspected as frequently as necessary everywhere in the pollution zone and that minor or insignificant sources were inspected less frequently.

The scheduling of inspection assignments is based on the data and experience gained from previous inspections. It requires that all files and record-keeping be classified and maintained on a continuous basis so that the number of plants ready for inspection may be compiled each month for each sector. Such a system can be based on a Master Punch Card and Key Sorting System used for selective analysis of master record cards, described in Part VII "Maintaining Record Systems" of this chapter. In the Enforcement Division a list of such plants is forwarded from the Records Section to the Head Inspectors for scheduling.

The frequency of inspection is based on some measure of the complexity of the plant as indicated by the number of equipment units, the type of equipment and processes employed, and the time required to conduct reinspections. A larger and more complex plant will, in general, have a higher degree of probability for change and, hence, will be susceptible to permit infractions. Such plants require more time to inspect, and must be inspected more frequently. The frequency of reinspections assigned to industrial plants ranges from less than once per year (Frequency "O") to three times per year.

3. Specialized and Selective Enforcement

In fashioning an enforcement program to the needs of a complex industrial economy, it soon becomes apparent that assignments made solely on the basis of sectors restricts the field operation to the handling of only the most common types of enforcement problems. The adequacy and thoroughness of the inspections of technologically complicated industries are left to chance and to the initiative and interest of the sector inspector. It is obvious that to adequately inspect these industries it is necessary to assign inspectors with special training or qualifications. This approach is known as specialized enforcement. It is intended to bring to each significant air pollution problem the special skills that may be required.

Specialization has already been noted in the functions of the Engineering Inspector and the Patrol Inspector. Engineering Inspectors are assigned to one of two specialized sections, the Industrial Engineering Inspection Section, and the Refinery and Chemical Inspection Section (see Figure VI-1). Within each of these sections are two further divisions of personnel, the sector inspectors, and special inspectors or "selective" enforcement teams. In the Patrol Section, inspectors may further specialize into a Vehicle Unit (trucks and buses), ship inspection at marine terminals, agricultural and open burning situations, and surveillance of plants in special enforcement problems.

Specialized enforcement is intended to provide: (1) the special skills required to conduct routine inventory and other inspections in complicated or highly technical industries, and (2) a procedure which brings to the attention of field personnel those chronic or marginal air pollution problems which may exist or develop in any industry and which require unusual treatment. This second phase is referred to as "selective" enforcement. These programs are necessitated by the lack of effective control techniques within certain industries, or by sensitive air pollution problems requiring strict supervision of operating and maintenance practices inside the plant. To illustrate a few of these situations: some industries may be the object of continuous complaints and may repeatedly create a public nuisance in a general locality, even though the industry may otherwise operate in compliance. Others may operate equipment which continuously emits opacities of pollutants just below violation thresholds. Others may employ equipment which is obsolete and inadequate by current control standards, but are permitted under the grandfather clause (Rule 13).*

Assignments are made by industry, or by related production or process units. For example, the Refinery and Chemical Section of the Enforcement Division is generally assigned all industries which are either related in process, in principle, or in complexity to oil refining, production and manufacture of petroleum products, chemical manufacturing, chemical derivatives and related industries. Detailed assignments are made to the following:

1. Oil Production and Transportation Facilities.
2. Petroleum Refineries.
3. Tank Farms.
4. Petroleum Marketing Stations, Bulk Plants, Service Stations, Marine Terminals.
5. Gasoline Absorption Plants.
6. Sulfur Recovery Plants.
7. Petrochemical Plants.
8. Chemical Plants.
9. Asphalt Roofing Plants.
10. Asphalt Manufacturing Plants.
11. Paint and Varnish Manufacturing.
12. Soap and Detergent Manufacturing.
13. Public and Private Power Plants.
14. Oil Reclaiming Plants.

The oil refining industry, itself, representing an unusually high degree of industrial complexity, is further unitized for special assignment as follows:

Separation Processes
1. Fractional Distillation Unit.
2. Gas Absorption Unit.
3. Solvent Extraction Unit.

Conversion Processes
1. Cracking, TCC and FCC Units.
2. Polymerization Unit.
3. Alkylation Unit.
4. Hydrogenation Unit.
5. Dehydrogenation Unit.
6. Isomerization Unit.
7. Reforming Unit.
8. Hydroforming and Platforming Units.

Manufacturing of Products
1. Gasoline.
2. Grease, etc.

a. "Selective" Enforcement

While specialized enforcement refers to the total enforcement treatment of an entire class of industry (such as oil refineries and chemical plants), "selective" enforcement brings to complicated air pollution *problems* the skills of inspectors with appropriate technical training and knowledge. Selective enforcement is primarily interested in obtaining final solutions to chronic pollution problems which are not adequately defined, or for which no adequate inspection or control techniques exist, and to provide intelligence for possible administrative or even extra-legal solutions to these problems.

Since the inspectors of the Refinery-Chemical Section of the APCD possess a level of expertise which enables them to conduct thorough inspections in refinery and chemical plants, and to also handle other industrial problems within their geographical area), selective enforcement functions in that section are conducted on a routine basis. In the Industrial Inspection Section, however, special selective enforcement assignments, distinct from routine sector assignments, are necessitated due to the large variety of industries and air pollution problems handled by that section. In particular, engineering inspectors are assigned to the following:

Rendering plants and Smokehouses
Chemical Plants
Paint and Plastics Industries
Ferrous Metals
Non-Ferrous Metals
Dusty Industries
Paint Spray Installations
Special Investigations

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* This APCD Rule automatically grants permits to equipment constructed prior to February 1, 1948. See Chapter 14, REGISTERING THE SOURCES OF AIR POLLUTION.

The engineering inspectors involved perform a number of functions concerning the technical aspects of the air pollution problems of these industries. These include:

1. Keeping abreast of the technological advances and changes which may affect air pollution potentials or compliance.
2. Making determinations and appraisals of air pollution and nuisance potentials in these industries.
3. Informal suppression of air contaminants not adequately covered by existing rules. Concerted effort at control may result in the complete control of housekeeping problems which may be individually of a minor nature, but collectively significant.
4. Gathering of data in relation to the above and to the exploitation of "loop-holes" in the laws. These data may be used in the promulgation of new rules or amendments.
5. Determination of the possibility of emission of "invisible" contaminants by careful scrutiny of industrial process, or by recommending source testing.
6. Achievement of certain control of marginal and chronic violators.
7. Conducting general liaison and public relations with industrial plants to induce favorable conditions for cooperation and voluntary action.
8. Handling of problems referred from other inspection sections and personnel, as well as inspections and follow-ups involving denials, variances, engineering final reports, violation notices involved with these industries, and special memoranda and instructions issued by the Director of Enforcement and his staff.
9. Conducting surveys involving special situations such as Rule 62, filter controls, etc.
10. Providing technical assistance and training for other enforcement personnel.

The selective enforcement process consists of review and enforcement functions. The review function consists of (1) preparation and maintenance of status charts for all industries which may have unique, chronic, or difficult types of air pollution problems, from data supplied from inspection and enforcement records, and (2) evaluation of these data to determine either the nature of the specific problems occurring in these industries, or the absence of information required to make a thorough evaluation of compliance.

The sources of air pollution which require attention are then inspected to obtain a complete compliance determination, or to initiate remedial measures or enforcement action. The inspection may be conducted jointly with the sector inspector involved, with a senior engineering inspector, or individually by the selective enforcement inspector. Selective Enforcement personnel also perform relief inspections in the absence of the regular sector inspectors.

4. Aerial Inspection

A ready check on all of the activities in the pollution zone can be made daily from an airplane. With reasonable visibility an aerial observer can instantly detect any plume anywhere in the pollution zone. A trained observer, by means of maps, can identify the location of the plume and, in some instances the industry involved or even the company name. Observers are thus experienced with the layout of the pollution zone as well as the sources. The effectiveness of aerial inspection, however, depends on whether or not a radio-communications system is employed by the agency since that is the only satisfactory means by which field units can be directed to the source of pollution being observed.

Aerial inspection is especially useful as a check on actual ground field coverage, but it cannot substitute for that coverage. A.P.C.D. experience has shown that most sources observed from the air are independently observed by ground units. In other instances, ground units are not able to get through traffic or travel the long distances involved to reach the source reported by the aircraft in time to observe a violation. Aerial inspection is further limited to days of good visibility and daylight hours.

5. Citizens' Reports and Complaints

The public itself is also in a position to observe and to report special pollution problems or nuisances since individuals tend to be sensitive to any visible plumes or clouds of pollution in the community. In this case, the surveillance factor is virtually universal and continuous.

In the Los Angeles Basin, for example, not only is the public aroused to the general smog problem, but the basin is so inhabited as to expose most of the sources of air pollution to ordinary observers. The basin is primarily a flat land area from which plumes of air contaminants may be observed at long distances, and especially from the many homes located in the hills surrounding the basin and valley areas. Moreover, due to the rapid growth of the Los Angeles area, zoning of property has not progressed on an orderly basis, at least from the point of view of air pollution control. Consequently, many residential areas have been surrounded by large industrial sources of air pollution.

The complaints resulting from this condition are of great assistance in locating and determining frequency of violations and in directing inspectors to the violations *when they occur*, and to the major sources of air pollution. By means of a radio-communication system, and the deployment of zone inspectors, it is thus possible to dispatch field inspectors to the sources of air pollution complained of during the time of the

Figure VI - 4. Aerial observation of a source of air pollution: weed burning, North Long Beach.

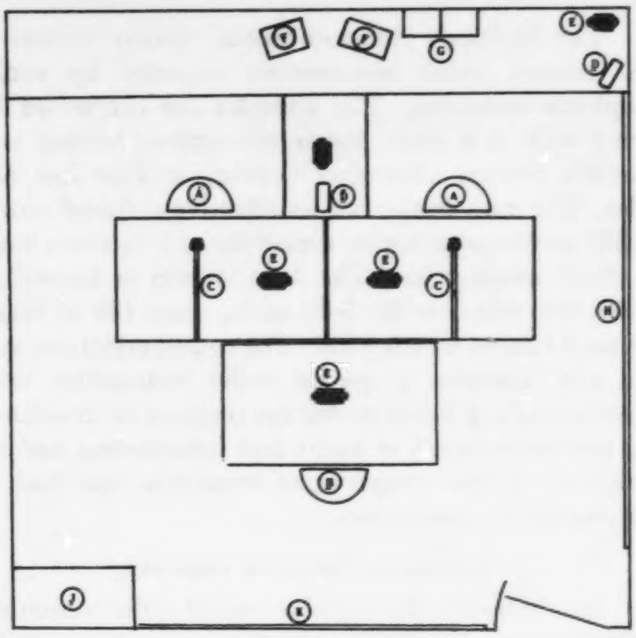

Figure VI - 5. Layout of A.P.C.D. Communications Center. A—operator positions, B—watch commander's position, C—microphones (on booms), D—time stamping machines, E—telephones, F—radio consoles, G—automatic coding transmitters, H—bulletin board for memos and instructions, J—metal file drawer for filing of radio logs as required by the F.C.C., K—large sector reference map of Los Angeles County.

Figure VI - 6. A.P.C.D. Communications Center.

violation. This is an important factor since no legal action can be taken *unless* the inspector witnesses the violation and all of the attendant facts.

6. Radio Communications

An important aid to the detection of the sources of air pollution is the use of radio-communications system for the instruction, integration, and location of all field units. In Los Angeles, a radio-communications system became necessary for the following reasons:

1. Preparedness in enforcing the emergency prevention regulations made the use of a radio-communications system mandatory.
2. Necessity to reach complainants and violators quickly to obtain the necessary evidence.
3. Field units require certain types of information necessary to completing inspections. Such information pertained to status of variances and reported breakdowns which are available at Headquarters.
4. Headquarters may require the immediate disposition of any complaint handled, or any air pollution problem of special interest.
5. Where activities are specialized into distinct field units such as Refinery and Chemical, Patrol and Industrial, field coordination may be conducted satisfactorily only by means of radio communications.
6. In order for aerial inspection to be of any practical use, a radio-communications system is necessary to transmit information from aerial to ground units.
7. It is also desirable that Supervisors be able to dispatch special instructions to field units as may be required.

The District's communications system consists of two console radio transmitters operated by radio-telephone operators. The consoles are connected by direct wire to a main power transmitter located at a Sheriff's Station (Biscailuz Center) in East Los Angeles. The transmitter has an effective radiated power of 250 watts operating on a modulated frequency band of 39.98 megacycles. The base station is known as KMF 964, whereas the field units, some 100 of them, are each known as KA 4306. The communications system also contains a special radio transmitter with selective calling facilities for the purpose of broadcasting the declarations of alerts and information and instructions to the categories of industries specified in the emergency regulation.

7. Emergency-Response Capability

In addition to the use of a central radio communications system, the black-and-white emergency vehicle equipped with sirens and lights, as authorized by Section 120 of the California Motor Vehicle Code, and used in patrol duty, has greatly facilitated the emergency-response capability of the District.

The very nature of air pollution control operations in Los Angeles County has required an alert and swift field response capability. Particularly with respect to air pollution emergencies, inspectors must be prepared to reach any point in the 1200 square mile area of the Los Angeles Basin in sufficient time to observe emissions of toxic contaminants, determine their identity and concentration, ascertain the existence or non-existence of a hazard, warn inhabitants, locate the source of the contaminants and the cause of the emission, notify responsible parties to obtain immediate corrective action, and secure the proper evidence in order that violations of the law may be prosecuted to deter re-occurrence of such episodes. Unlike most other types of law enforcement activities for which evidence can be secured after a crime has been committed, in air pollution enforcement work, legal evidence can only be obtained on the scene and at the time of the violation or emergency by a qualified member of the A.P.C.D. Obviously, considering traffic congestion, and the size of Los Angeles County, this response capability depends entirely on radio-communications and on the geographical deployment of emergency vehicles.

The emergency vehicle is required in Los Angeles County to enforce and implement various provisions of the Health and Safety Code, the Rules and Regulations, particularly Regulation VII (Emergencies), and Section 27153 (excessive emissions from motor vehicles) of the Vehicle Code. It enables personnel of the District to:

1. Respond to localized air pollution dangers and disasters.
2. Implement any orders given by the Air Pollution Control Officer during a Regulation VII alert.
3. Maintain emergency access to the roadways, streets, highways and freeways of Los Angeles County during Regulation VII alerts.
4. Provide supplementary on-the-spot sampling of atmospheric contaminants in areas of unusually severe contamination during a Regulation VII alert.
5. Provide access to air monitoring stations during such alerts.
6. Verify industrial shutdowns called during an alert.
7. Assist in the curtailment of vehicular traffic during an alert.
8. Coordinate activities of other enforcement agencies during an alert.
9. Halt, inspect and cite moving motor vehicles in violation of air pollution control laws on the roadways.
10. Monitor radio-active contaminants resulting from accidental discharge or from nuclear war.

III INSPECTION OF THE SOURCES OF AIR POLLUTION

The next step in field control operations is the inspection of equipment in the industrial and commercial plants located in the inspection sectors. The smallest and most important unit of inspection is the *equipment unit* — that unit of equipment which would legally constitute a single source of emission. Most often the equipment unit is a single piece of equipment: a boiler, a furnace, an incinerator, constituting the equipment unit or the single source of emission.*

Two types of inspections are made of equipment units: (1) violation inspections, and (2) inventory inspections. We may also consider, in relation to these inspections, follow-up and periodic reinspections, and complaint and miscellaneous inspections.

A. Violation Inspection

The violation inspection is usually conducted on the occasion of observing a violation of a legal standard committed by, or involved with, a single equipment unit. The violation may be observed by an inspector patrolling an area, or by an inspector inside of the plant. There are three phases of the violation inspection: (1) observation, (2) investigation, and (3) report and notification.

The first phase of the violation inspection consists of the observation of the violation by determining the excessive emissions of air contaminants, by substantiating the existence of a public nuisance, or by determining illegal construction or operation of equipment. These three broad categories of violations in turn involve more than 20 different laws and rules which the inspector enforces (see Chapter 3).

The second phase of the violation inspection concerns the investigation which is made to determine the facts and to obtain evidence as to the causes of the violation, such as responsibility, operation and design factors contributing to the violation.

The third phase of the violation inspection consists of the writing and serving of a written *Notice of Violation*, if the equipment involved is stationary, or a *Citation*, or *Vehicle Notice*, if the equipment is a motor vehicle. The Notice or Citation is written to include an accurate description of the violator, ownership responsibility, or negligence involved in the commission of the violation, and the cause of the violation in order to establish a prima facie case in the event that legal action is taken.

B. Inventory Inspection

The inventory inspection is conducted for the purpose of identifying and listing all equipment units capable of emitting air pollution located in all individual commercial, industrial and governmental establishments. Unlike the violation inspection, the inventory inspection groups equipment units into activities or source locations. The inventory inspection thus assures the registration of all important sources of air pollution in the pollution sector. In particular it provides:

1. A record and identification of all equipment capable of emitting air contaminants at each activity location.
2. Determination of the exact permit status of each piece of equipment and all permit infractions.
3. A reference file which will assist inspections and investigations of public nuisances or violations.
4. Systematic coverage of sectors and statistical tabulation to determine work-load requirements.
5. Data for the construction of Plant Status Charts for use in special enforcement activities. Status charts for use in special enforcement activities.

The inventory inspection is the most complete type of inspection made of source activities since it requires a detailed inspection of each piece of equipment involved. The inspector conducting the inventory inspection ascertains compliance with *all* of the Rules and Regulations and the State Laws affecting air pollution.

The inventory inspection may lead to a number of subsequent actions. An *APCD Permit Request* may be issued for equipment which requires a permit or a Notice of Violation may be written for excessive emissions, or alteration or illegal construction of equipment.

C. Follow-up and Reinspection

Both violation and inventory inspections may involve follow-up inspections. For one reason or another, the inspector may not be able to complete all three phases of the violation inspection on his initial inspection stop and he may be required to return at some other time to gather all of the evidence. The inventory inspection may also involve several follow-up inspection stops. If a permit request is issued, a follow-up may be required to assure the submission of applications, or if equipment is being constructed without authorization, a follow-up will be required to determine that unauthorized construction is not continuing. Each stage in the process of obtaining a permit may, in fact, require a follow-up reinspection.

D. Complaints and Miscellaneous Inspections

Other types of inspection involve investigation of public nuisances, breakdown of equipment, answering complaints, follow-ups on denial of applications, variances, engineering final field reports, and any other assignments which may be necessitated.

The collection of data for each of these categories of inspections is discussed in greater detail in following Chapters of this manual.

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* For definition of equipment unit, see Chapter 14.

IV REPORTING RESULTS OF INSPECTIONS

The field report is a record of an event occurring at a specific time in relation to an actual or potential air pollution problem. Although it is not evidence itself, it constitutes the relevant facts upon which an event can be reconstructed into evidence in a court of law. The inspector's report also provides data from which enforcement operations and inspection technique can be improved.

The inspector prepares a report covering his inspection made of equipment units at each location. As a means of definitely fixing responsibility for the ownership and operation of equipment units, all reports are titled and filed according to the name of the company or individual, and the address of the location inspected.

Field reports fall into three general types: (1) investigative, (2) descriptive and statistical, and (3) administrative or work reports.

A. Investigative Reports

In an investigative report the inspector relates the facts developed from a physical inspection of equipment units involved in a specific or potential air pollution problem. The object of the report is to determine whether the equipment violates a standard, is capable of violating the standard or complies with the standard.

The investigation report consists basically of five parts: (1) corporate and/or individual responsibility, (2) identification and location of the equipment unit(s) being investigated, (3) the Findings, consisting of a report of the objective facts, (4) statements of all persons made under interview, and (5) conclusions and recommendations made by the investigating inspector. (See Chapter 7.)

The investigative report is designed and written so as to enable a reviewer to readily reconstruct the incident. If the situation covers a violation, all of the elements of a *corpus delicti* are logically incorporated into the report. (See Chapter 13.)

Investigative reports are acted upon in two distinct ways. In one instance the report is *negative* — no legal action is required; in the other, it is *positive*, the report must be processed towards prosecution of the violator. A negative report is made on an *Inspector's Report* (Figure VII-7), an *Activity Status Report* (Figure XIV-9) or other functional or specialized types described below. The positive report is usually made on a *Notice of Violation* (Figure XIII-1) or *Citation* (Figure XIII-4) as described below.

1. The Inspector's Report

The Inspector's Report is a general report made of the results of an inspection. It does not immediately initiate court action. In the main, this report develops ownership data, location and identification of the source of air pollution, responsible parties contacted, the inspector's findings, recommended action and referral notations. When filed, these reports evolve into case histories for use in future enforcement work.

In the A.P.C.D., various forms of the Inspector's Report are used. The Inspector's Report (see Figure VII-7) is used to cover investigations made of complaints, reported breakdowns of equipment, permit-denial and permit follow-up inspections, and other situations in which the findings may be briefly reported. Another form of the general Inspector's Report is the *Activity Status Report* (see Figure XIV-9) which is limited primarily to (1) reporting results of specialized or technical inspections such as those concerning complicated flow of processes or products and (2) reporting changes in permit status, inventory or compliance on inventory reinspections when a new Equipment List (see below) is not required.

Other forms of Inspector's Reports may be designed to cover the inspection of just one type of equipment (such as a gasoline storage tank) or a situation or circumstance involving a specific rule (such as Rule 10, Permits Required, etc.). These reports tend to be mostly of the standardized-blank completion variety, since the same information is required in each case. An example of this type may be found in Figure XIII-7, *Inspector's Questionnaire for Steamships* which concerns boilers only. In this form all of the data required is categorized and presented so that it can be supplied merely by filling in the required information.

A circumstantial report, on the other hand, may be typified by the *Request to Apply for APCD Permit* (see Figure XIV-17). This report is made when a piece of equipment requires a permit. The Findings on the form are broken down into categories which document the reasons the application for permit is mandatory. Such data as "date construction started", "degree of construction", "reason permit is required", "date permit became necessary", etc., are completed in the proper spaces on the form.

In the sense that the operator is notified that a permit is required, and must submit the applications or face the legal consequences under permit requirements (Rule 10), the *Request* is positive. However, since no legal action is intended by the request itself, it is here considered as a negative report requiring a follow-up inspection (permit follow-up inspection).

2. Notice of Violation

This is a positive report form since its very use indicates that legal action is required. The Notice contains the essentials of the Inspector's Report described above but, in addition, presents a more rigorous description of the Findings in order to establish a *prima facie* case. It also prominently displays a specific charge made in the second person to the violator, declaring that a violation of a state code section or District Rule has been committed (see Figure XIII-1). A duplicate copy of the charge portion of the

Notice is served to the violator. The original copy reports the findings of the investigation on the reverse and is forwarded to the inspector's supervisor for review and preparation of the court case. In the A.P.C.D., the Notice of Violation takes two forms, the "F-type" for stationary sources of air pollution, and the "V-type" for vehicular sources when Section 24242 is being applied only (see Figure XIII-5).

3. The Citation

The *Citation* is another form of a positive report but is limited to citing violators of Section 27153 of the California State Vehicle Code, which prohibits excessive emissions from vehicles. The citation differs from the Notice in that it constitutes the court complaint itself. The Notice, on the other hand, requires preparation of a separate court complaint, and has no legal force in itself.

The citation is made in quadruplicate. The first copy is the court complaint, the second is reviewed and filed for record, the third is the driver's copy, and the fourth is retained in the citation book to refresh the inspector's memory should he be required to appear in court (see Figure XIII-4).

B. Descriptive Reports

The second type of report is the *descriptive* report. This type is used to cover all situations in which the investigation sequence is not employed, and the primary purpose of the inspection is to list or to identify equipment, or to describe or draw flow processes, or to present data for subsequent statistical tabulation.

The most important descriptive report used by the A.P.C.D. is the *Equipment List* (see Figure XIV-3). This is a record made of the inventory inspection itself. It is used to inventory all sources of air pollution which may be found at industrial or commercial locations. It consists of the following report sections: (1) all pertinent ownership and plant responsibility data, (2) descriptive identification of each piece of equipment in the plant, (3) determination of the permit status of each piece of equipment, and (4) the reinspection record. The Equipment List also classifies other information to assist in scheduling work assignments in the inspection sectors. (See Chapter 14 for detailed explanation of the *Equipment List* and other descriptive reports.)

C. Work Reports

The work report or, as it is known in the A.P.C.D., the *Daily Report*, is a daily record made by the inspector of all inspection stops and reports made, in chronological order of performance as well as any other field or office work not involving inspection (see Figure VI-7).

The Daily Report is used for review purposes, to check completion of assignments, work efficiency and to tabulate the number of inspections or man-hours spent in the field in the various categories of field duties. The Daily Report also shows sector coverage in terms of areas patrolled, plants observed and miles driven.

V. REVIEW AND DISPOSITION OF REPORTS

The review process, in essence, is intended to maximize and validate the data and evidence collected by the inspector since important legal use may be made of this information at any time.

All of the reports, together with the Daily Report, are assembled each day by the inspector's immediate supervisor, the Senior Engineering Inspector, for review, correction and disposition. The Senior Inspector performs the following when reviewing the reports:

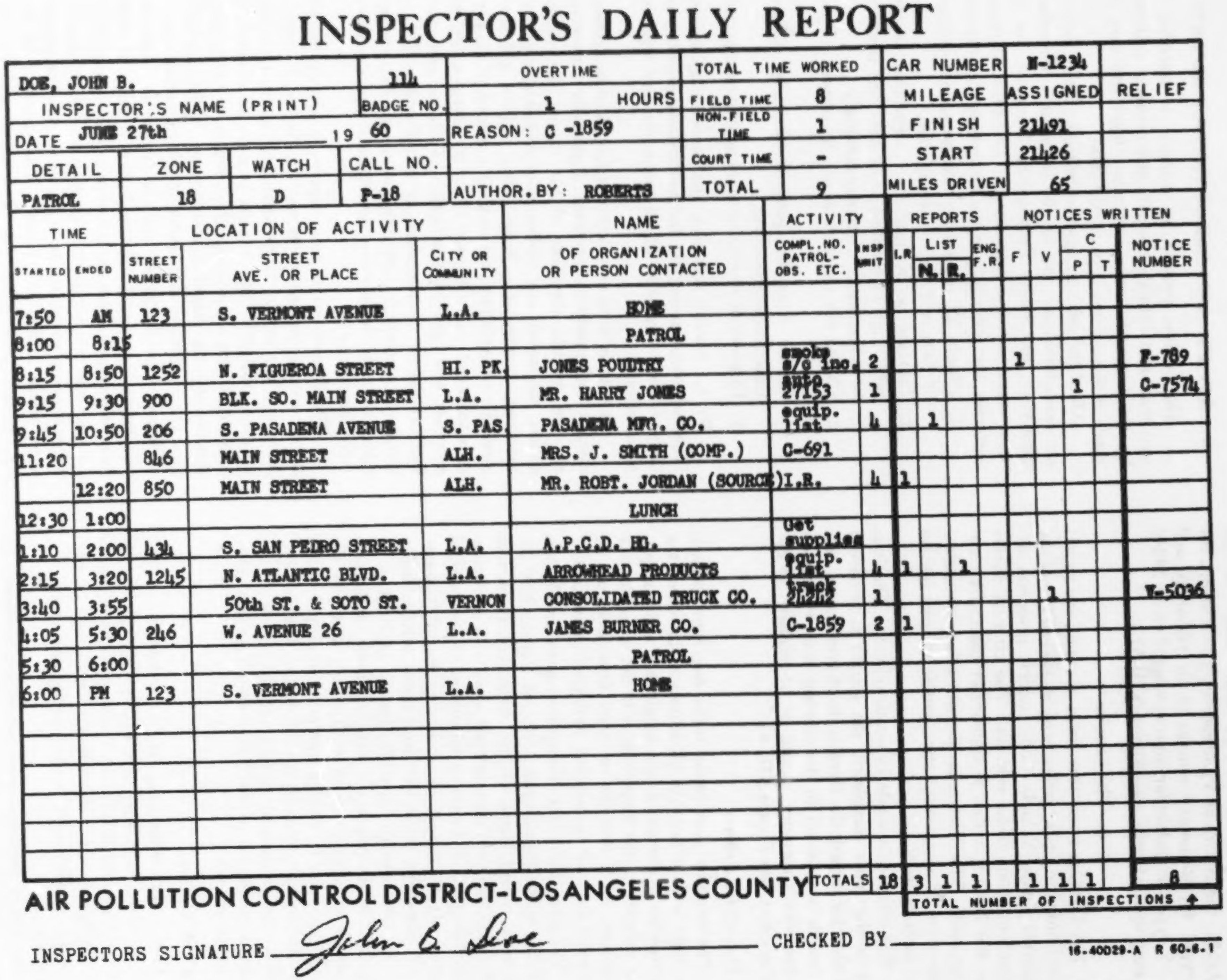
1. Checks all reports for accuracy, completeness of data or evidence of violation.
2. Corrects or returns for correction reports which are incomplete or in error and instructs or trains the inspector accordingly.
3. Checks the completion of all assigned inspections.
4. Checks work for general efficiency, ability, conscientiousness, etc.
5. Disposes of reports or takes appropriate action.

By his review function, the Senior Engineering Inspector coordinates field and headquarters operations towards the completion of all inspection and enforcement activity.

In determining accuracy, reports must be systematically and carefully checked. Especially important are the specific elements of the crime, the *corpus delicti*, the names and addresses of responsible parties involved, opacity and Ringelmann values and time intervals of violations, as well as a record of all persons involved (see Chapter 13). In permit cases, an accurate and specific description of status and such facts as degree of alteration or modification, date of change of ownership, relocation of equipment, exemptions, must be accurately ascertained and described (see Chapter 14).

The disposition of most reports is predetermined since routine processing is set up for each report. Actually, the action to be taken is initiated by the inspector himself. The review process, in essence, is concerned with confirming, challenging, or correcting, if necessary, the inspector's judgment. If the inspector observes a violation and is able to collect the necessary evidence, then he must write a Notice or Citation, whichever is the case. If the Notice is valid, it must then be processed towards prosecution. If the inspector does not observe a violation, or he is unable to acquire the necessary evidence, then he must use the proper form of the inspector's report. The function of the report thus determines the disposition and routing procedure, as follows:

1. If the report is a *Citation*, *Notice of Violation*, or an Inspector's Report recommending legal



INSPECTOR'S DAILY REPORT

DOE, JOHN B. — INSPECTOR'S NAME (PRINT)
BADGE NO. 114
DATE JUNE 27th 19 60
DETAIL PATROL
ZONE 18
WATCH D
CALL NO. P-18
OVERTIME 1 HOURS
REASON: C-1859
AUTHOR. BY: ROBERTS
TOTAL TIME WORKED
FIELD TIME 8
NON-FIELD TIME 1
COURT TIME -
TOTAL 9
CAR NUMBER N-1234

MILEAGE	ASSIGNED	RELIEF
FINISH	21491	
START	21426	
MILES DRIVEN	65	

TIME		LOCATION OF ACTIVITY			NAME	ACTIVITY		REPORTS				NOTICES WRITTEN				
									LIST					C		
STARTED	ENDED	STREET NUMBER	STREET AVE. OR PLACE	CITY OR COMMUNITY	OF ORGANIZATION OR PERSON CONTACTED	COMPL. NO. PATROL-OBS. ETC.	INSP UNIT	I.R	N.	R.	ENG. F.R.	F	V	P	T	NOTICE NUMBER
7:50	AM	123	S. VERMONT AVENUE	L.A.	HOME											
8:00	8:15				PATROL											
8:15	8:50	1252	N. FIGUEROA STREET	HI. PK.	JONES POULTRY	smoke s/c inc.	2					1				F-789
9:15	9:30	900	BLK. SO. MAIN STREET	L.A.	MR. HARRY JONES	auto 27153	1							1		C-7574
9:45	10:50	206	S. PASADENA AVENUE	S. PAS.	PASADENA MFG. CO.	equip. list	4		1							
11:20		846	MAIN STREET	ALH.	MRS. J. SMITH (COMP.)	C-691										
	12:20	850	MAIN STREET	ALH.	MR. ROBT. JORDAN (SOURCE)	I.R.	4	1								
12:30	1:00				LUNCH											
1:10	2:00	434	S. SAN PEDRO STREET	L.A.	A.P.C.D. HQ.	Get supplies										
2:15	3:20	1245	N. ATLANTIC BLVD.	L.A.	ARROWHEAD PRODUCTS	equip. list	4	1		1						
3:40	3:55		50th ST. & SOTO ST.	VERNON	CONSOLIDATED TRUCK CO.	truck 24242	1						1			V-5036
4:05	5:30	246	W. AVENUE 26	L.A.	JAMES BURNER CO.	C-1859	2	1								
5:30	6:00				PATROL											
6:00	PM	123	S. VERMONT AVENUE	L.A.	HOME											
						TOTALS	18	3	1	1		1	1	1		8

AIR POLLUTION CONTROL DISTRICT-LOS ANGELES COUNTY

TOTAL NUMBER OF INSPECTIONS ↑

INSPECTORS SIGNATURE John B. Doe CHECKED BY

16.40029-A R 60-6-1

Figure VI-7. The Inspector's Daily Report is used to report chronological inspection and enforcement activities, and to tabulate the results of such activities.

action, it is forwarded to the Investigation Detail for court processing (see Figure VI-8).

2. If the report is a *Request to Apply for APCD Permit*, or other inspector's report covering permit matters, a copy is kept in suspense for follow-up inspection to assure submission of applications, and another copy is forwarded to alert the Engineering Division to the forthcoming applications and to provide data essential to permit processing.
3. If the inspector's report calls for further investigation or surveillance before the matter can be resolved, it is referred to the appropriate sector or special inspector.
4. If the inspector's report resulted from an assignment, it is referred to the assignor.
5. If the inspector's report involves a policy decision, it is referred to the appropriate staff member.
6. If the inspector's report requires no further action due to resolution of the problem or lack of evidence, it is filed for reference.

Any given report may be viewed as *terminal* or *inconclusive*. A terminal report is a report in which the field action is reported to be completed, and is filed. An inconclusive report is a report in which the field action is reported as being incomplete or inconclusive, thus requiring further investigation. Inconclusive reports cover situations in which not all of the necessary evidence is collected, or inspection results are negative, but a violation is suspected, or processes are so complicated or extensive that data must be gathered by means of joint or coordinated inspections, or an air pollution problem is involved for which there is no established legal solution.

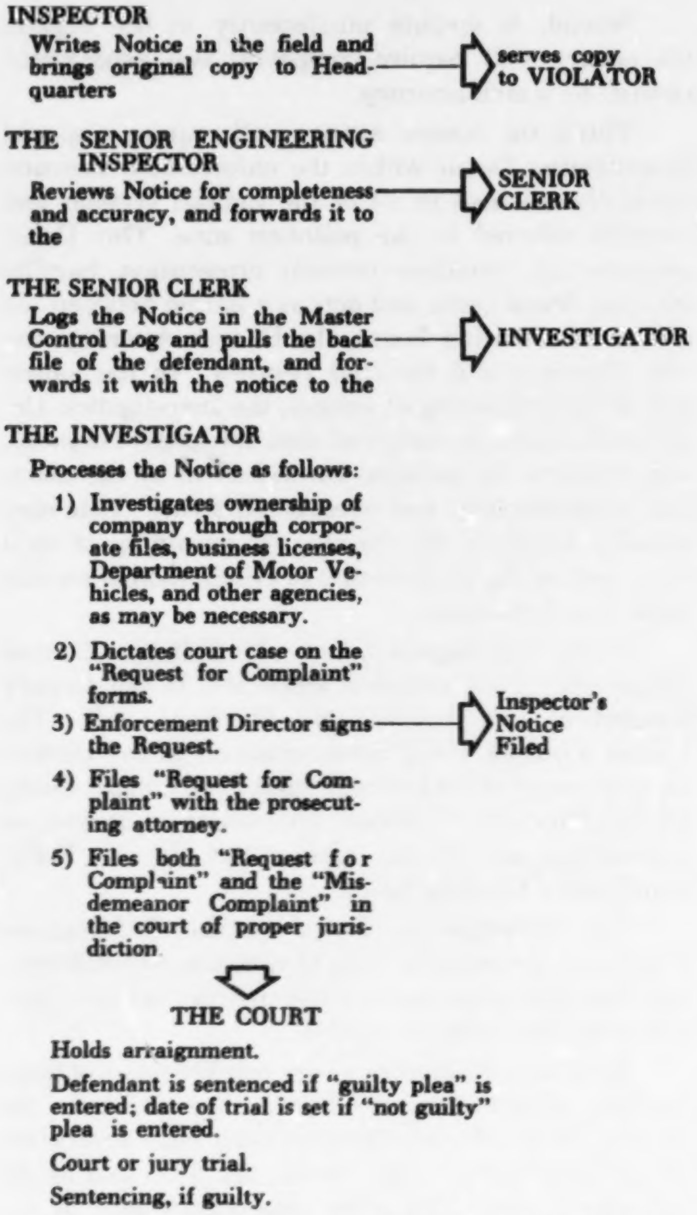
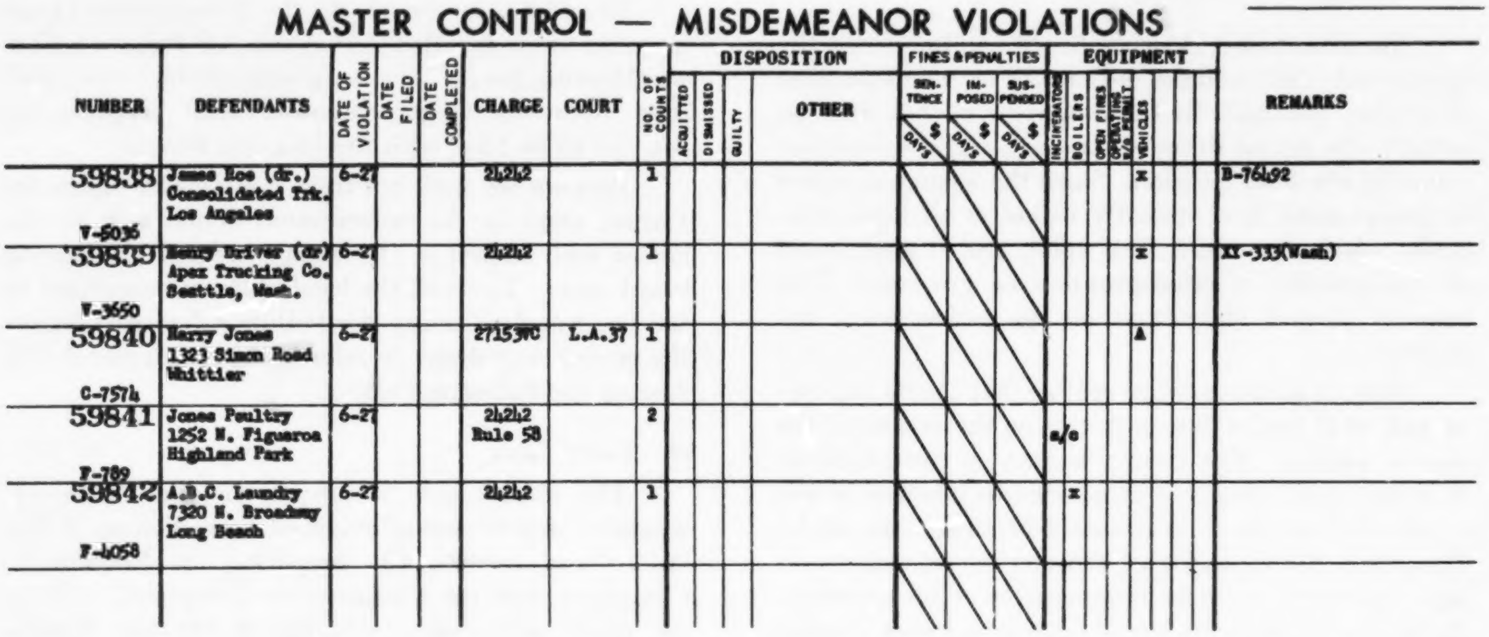

INSPECTOR
Writes Notice in the field and brings original copy to Headquarters
serves copy to VIOLATOR
THE SENIOR ENGINEERING INSPECTOR
Reviews Notice for completeness and accuracy, and forwards it to the
SENIOR CLERK
THE SENIOR CLERK
Logs the Notice in the Master Control Log and pulls the back file of the defendant, and forwards it with the notice to the
INVESTIGATOR
THE INVESTIGATOR
Processes the Notice as follows:
1) Investigates ownership of company through corporate files, business licenses, Department of Motor Vehicles, and other agencies, as may be necessary.
2) Dictates court case on the "Request for Complaint" forms.
3) Enforcement Director signs the Request.
Inspector's Notice Filed
4) Files "Request for Complaint" with the prosecuting attorney.
5) Files both "Request for Complaint" and the "Misdemeanor Complaint" in the court of proper jurisdiction.
THE COURT
Holds arraignment.
Defendant is sentenced if "guilty plea" is entered; date of trial is set if "not guilty" plea is entered.
Court or jury trial.
Sentencing, if guilty.

Figure VI-8. Processing of written notices of violation.



MASTER CONTROL — MISDEMEANOR VIOLATIONS

NUMBER	DEFENDANTS	DATE OF VIOLATION	DATE FILED	DATE COMPLETED	CHARGE	COURT	NO. OF COUNTS	DISPOSITION				FINES & PENALTIES			EQUIPMENT								REMARKS
								ACQUITTED	DISMISSED	GUILTY	OTHER	SENTENCE DAYS $	IMPOSED DAYS $	SUSPENDED DAYS $	INCINERATORS	BOILERS	OPEN FIRES	OPERATING W/O PERMIT	VEHICLES				
59838 V-5036	James Roe (dr.) Consolidated Trk. Los Angeles	6-27			24242		1												x				B-76492
59839 V-3650	Henry Driver (dr) Apex Trucking Co. Seattle, Wash.	6-27			24242		1												x				XX-333(Wash)
59840 C-7574	Harry Jones 1323 Simon Road Whittier	6-27			27153VC	L.A.37	1												A				
59841 F-789	Jones Poultry 1252 N. Figueroa Highland Park	6-27			24242 Rule 58		2								a/c								
59842 F-4058	A.B.C. Laundry 7320 N. Broadway Long Beach	6-27			24242		1									x							

Figure VI - 9. The Master Control Log provides an accurate accounting of the disposition of each written notice issued by A.P. Inspectors.

The inconclusive report may require careful evaluation in order to determine the type of follow-up action that may be necessary. In these situations, the Senior Engineering Inspector reviews the findings carefully to determine from the facts and the inspector's recommendation, the inspection techniques and the reinspection schedule which should be employed. The report may then be returned to the inspector for reinspection, with special instructions, or it may be referred to special or selective enforcement teams, or to a patrol inspector for surveillance. In this way, all problems which arise are handled with the fullest competence in completing any given field action.

VI PROSECUTING VIOLATORS AND HANDLING HEARING BOARD CASES

Although court action may appear to be the concluding phase in the handling of an air pollution violation, it should be actually viewed as a link in a kind of circular process in which the decisions handed down by the courts tend to influence and regulate the field control operations program. This is done in two ways:

1. Each step in the field control operations program is conducted so as to be capable of furnishing the court or the APCD Hearing Board with the facts needed for a prima facie case, and any other facts from past records which are pertinent to a final disposition. Control operations are conducted *as if* legal action might be taken in each case, even though only a relatively small percentage of the sources inspected are violations.
2. The principles involved in court decisions, particularly at the appellate level, directly affect administrative practices, policies and inspection techniques.

The Court and Hearing Board's influence on the agency may be found not only in the actual disposition of a case, but both in the *anticipation* of a decision prior to the actual filing of the case, and the *interpretation* of the final decision. Since the agency is a part of government, it is ethically bound to all legal principles which the courts find valid, and it must avoid all malpractice or circumvention of principle. This imposes several obligations on the enforcement operation.

First, it is necessary to realize that courts are concerned with justice, not in justifying the actions of the control agency. The control agency is not infallible. It is the court's purpose to determine whether or not a defendant is guilty or innocent of allegations made. Therefore, the handling of court cases, as well as all legal matters, cannot be irresponsible or incompetent. To be so is to cause the loss of cases and, hence, control powers, by default.

Second, to operate satisfactorily in this regard, the agency will require competent and experienced counsel by a civil attorney.

Third, the control agency will require a special Investigation Detail within the enforcement function especially oriented to all of the judicial systems and counsels affected in the pollution zone. This Detail processes all violations towards prosecution, handles Hearing Board cases, and acts as a liaison between the courts, the Hearing Board, the District Attorney, the city attorneys and the civil attorney. In the liaison and in the processing of notices, the Investigation Detail must translate technical data into legal language, and translate the decisions handed down by the courts into administrative and operational terms. This may actually result in the training or retraining of field personnel, or the modification or elimination of certain inspection techniques.

In the Los Angeles County Air Pollution Control District the civil attorney employed is the County Counsel of Los Angeles and his legal staff. The County Counsel hands down opinions to the District on any matter or subject requested. The County Counsel also functions to initiate civil action in injunction proceedings and handles cases before the Air Pollution Control Hearing Board.

The Investigation Detail of the Enforcement Division processes *all* notices of violation received from the field operations groups towards prosecution, provided that the evidence is valid.

Most air pollution cases are misdemeanor actions, and are tried in Municipal or Justice Courts in the locality in which the violation occurred. Injunction proceedings, which occur rarely, are processed in the Superior Courts. Still other cases which may be appealed from Municipal or Justice Court decisions may be further heard in the appropriate appellate court.

In addition to the courts, the Investigation Detail prepares cases handled before the Air Pollution Control Hearing Board. These are initiated by correspondence with the County Counsel who prepares the petition to be filed with the Hearing Board.

Because we shall not treat it elsewhere again, the various steps in the enforcement action will be discussed with respect to (1) court cases and (2) hearing board cases. To recall the legal authority exercised by the Los Angeles County Air Pollution Control District, the reader may desire to refer again to Chapter 3, *The Law of Air Pollution Control.*

A. Court Cases

The steps taken to process violations are: (1) assembly and review of evidence from Notices of Violations and reports, (2) preparing the Request for Complaint, and the Misdemeanor Complaint, and (3) the court trial (see Processing of Written Notices, Figure VI-8).

1. Assembling Evidence from Notices of Violation

After the investigator receives the inspector's notice, he reviews it for sufficiency of a *prima facie* case. "Prima facie" means that there is sufficient evidence under the law to bring the case to a court test.

In establishing a prima facie case, the investigator abstracts the elements which comprise a corpus delicti from the inspector's Notice of Violation. These will include, in most violations: (1) Rule or State Code Section violated, (2) date and location of the violation, (3) the time of the violation, (4) the opacity or densities of the air contaminants, or other basic findings, (5) the identity of the air contaminants, i. e., "smoke", "dust", "mist", "fume", gas'", "vapor", (6) the names of the inspectors observing the violation, and (7) the owners and operators of the equipment responsible.

The above evidence is required for prosecutions involving excessive air contaminants. The elements required in permit, nuisance, open fires and other cases differ and are described in greater detail in Chapter 13. It will be sufficient here to show the type of evidence generally required to successfully prosecute cases involving operation of equipment without a permit as an example of how cases are handled in court. It should be noted that in these cases not all of the evidence required need be supplied by the inspector. Some evidence is supplied by the investigator and, in other cases, expert opinion is obtained from specialists on the District's staff.

Evidence in Court used to Prosecute Permit Cases.

1. A certified copy of the resolution of the Air Pollution Control District regarding the adoption of the Rules and Regulations, and a certified copy of the Rules and Regulations.
2. Stipulation or testimony given as to the ownership and location of the plant in violation.
3. Testimony by inspector and defendant as to the construction, use and operation of the equipment in question.
    a. Date of construction, if known, or determined in the course of the inspector's investigation. Occasionally evidence may be supplied from the seller, manufacturer or installer of the equipment involved.
    b. Testimony is given regarding the operation or status of construction at the time of the inspector's observation.
    c. Expert testimony as to the capability of the device to emit air contaminants.
    d. Testimony as to the inspector's determination that the equipment emitted air contaminants at the time of his inspection.
4. Testimony by investigator of the non-existence of permit or authority to construct, determined from a search of the A.P.C.D. records.

Should an important element of the evidence be lacking, despite the inspector's efforts, the investigator conducts his own investigation. Generally such investigations establish ownership and responsibility, employer and employee relationships, etc. In other cases the investigator may inspect the equipment in question himself to obtain any data needed to positively identify the air contaminants and to determine design characteristics and operational practices in establishing the cause of violation. In obtaining proof of continuity of ownership, the investigator may check with the corporate files, the Business License Bureau, the Department of Motor Vehicles, etc. Governmental agencies generally provide any information that is pertinent to establishing a prima facie case. The investigator may also check with installers and sellers to determine dates of construction or other information needed. Proof of employer-employee relationships, however, must usually be obtained from direct testimony of the defendants, or through the inspector's testimony of the owner's admission.

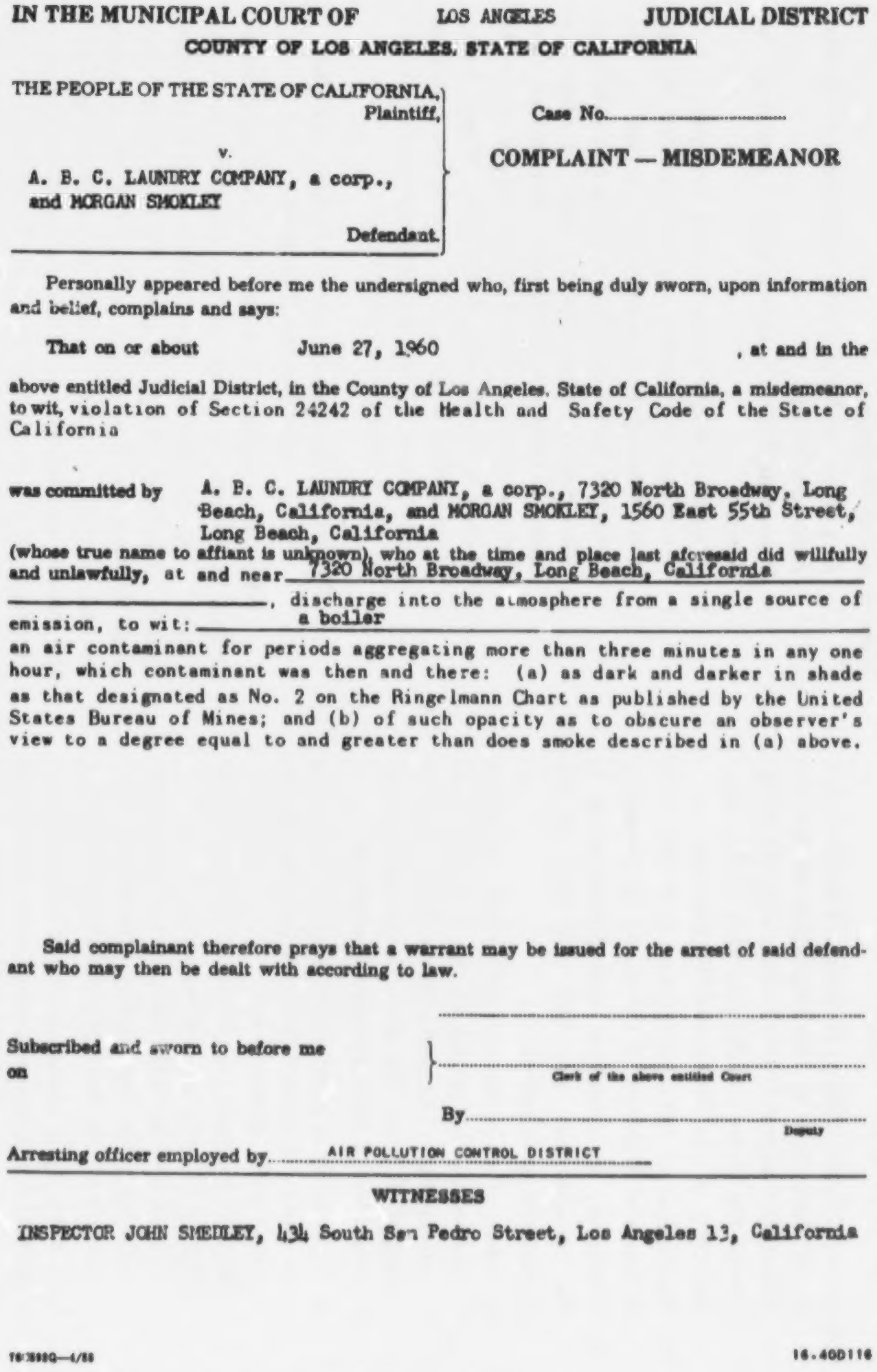
The procedures for processing Citations and other reports differ in some respects. The Citation need only be reviewed and filed with the proper court since it acts as the complaint itself.

Legal action can be taken by the Investigation Detail on the basis of any Inspector's Field Report that is not a Notice or Citation, provided that the evidence contained on the report is sufficient in establishing a prima facie case. For example, action can be taken on reports which disclose:

1. A public nuisance involving signed District Attorney Forms.
2. Non-compliance warranting revocation of permits.
3. Excessive smoke from private residences.
4. Violations observed in connection with exemptions, breakdowns, accidents or variances. For example, the claim that a given open burning operation is "agricultural" may be disproved upon subsequent evidence. Accidental fires and equipment breakdowns may later be shown to have been deliberate. When terms of variances are violated, reports are rendered on Inspector's Field Reports and are forwarded to the Investigation Detail.

2. Preparing the *Request for Complaint* and the *Misdemeanor Complaint*

When the evidence is assembled, it is then transcribed in its proper form on the "Request for Complaint" (Figure VI-10). The written Notice of Violation is then filed. The "Request for Complaint" contains the items of description similar to those contained on the Notice, i. e., the "visible emissions observed", the names and addresses of the defendants, the place of violation, the Section of the State Health and Safety Code or the Rules and Regulations violated, the source,



IN THE MUNICIPAL COURT OF LOS ANGELES JUDICIAL DISTRICT
COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

THE PEOPLE OF THE STATE OF CALIFORNIA, Plaintiff,
v.
A. B. C. LAUNDRY COMPANY, a corp., and MORGAN SMOKLEY
Defendant.

Case No.__________

COMPLAINT — MISDEMEANOR

Personally appeared before me the undersigned who, first being duly sworn, upon information and belief, complains and says:

That on or about June 27, 1960, at and in the above entitled Judicial District, in the County of Los Angeles, State of California, a misdemeanor, to wit, violation of Section 24242 of the Health and Safety Code of the State of California

was committed by A. B. C. LAUNDRY COMPANY, a corp., 7320 North Broadway, Long Beach, California, and MORGAN SMOKLEY, 1560 East 55th Street, Long Beach, California

(whose true name to affiant is unknown), who at the time and place last aforesaid did willfully and unlawfully, at and near 7320 North Broadway, Long Beach, California, discharge into the atmosphere from a single source of emission, to wit: a boiler

an air contaminant for periods aggregating more than three minutes in any one hour, which contaminant was then and there: (a) as dark and darker in shade as that designated as No. 2 on the Ringelmann Chart as published by the United States Bureau of Mines; and (b) of such opacity as to obscure an observer's view to a degree equal to and greater than does smoke described in (a) above.

Said complainant therefore prays that a warrant may be issued for the arrest of said defendant who may then be dealt with according to law.

Subscribed and sworn to before me on

____
Clerk of the above entitled Court

By__________ Deputy

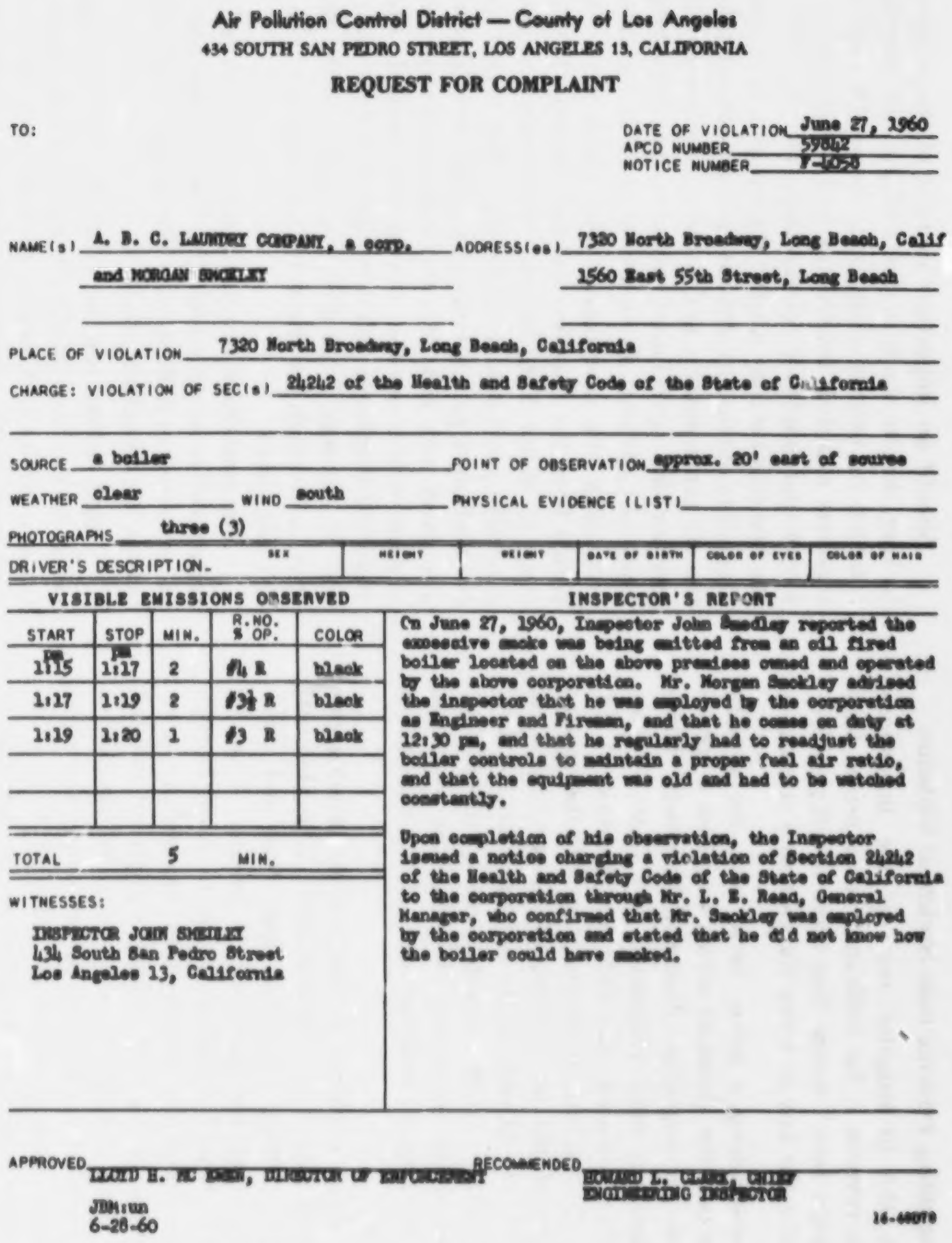
Arresting officer employed by AIR POLLUTION CONTROL DISTRICT

WITNESSES

INSPECTOR JOHN SMEDLEY, 434 South San Pedro Street, Los Angeles 13, California

[illegible] 16.400116

Figure VI-10. The Request for Complaint initiates court action at the A.P.C.D.



Air Pollution Control District — County of Los Angeles
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

REQUEST FOR COMPLAINT

TO:

DATE OF VIOLATION June 27, 1960
APCD NUMBER 59842
NOTICE NUMBER F-1058

NAME(s) A. B. C. LAUNDRY COMPANY, a corp. and MORGAN SMOKLEY

ADDRESS(es) 7320 North Broadway, Long Beach, Calif 1560 East 55th Street, Long Beach

PLACE OF VIOLATION 7320 North Broadway, Long Beach, California

CHARGE: VIOLATION OF SEC(s) 24242 of the Health and Safety Code of the State of California

SOURCE a boiler

POINT OF OBSERVATION approx. 20' east of source

WEATHER clear

WIND south

PHYSICAL EVIDENCE (LIST)

PHOTOGRAPHS three (3)

DRIVER'S DESCRIPTION. SEX	HEIGHT	WEIGHT	DATE OF BIRTH	COLOR OF EYES	COLOR OF HAIR

VISIBLE EMISSIONS OBSERVED

START	STOP	MIN.	R. NO. % OP.	COLOR
pm 1:15	pm 1:17	2	#4 R	black
1:17	1:19	2	#3½ R	black
1:19	1:20	1	#3 R	black

TOTAL 5 MIN.

WITNESSES:

INSPECTOR JOHN SMEDLEY
434 South San Pedro Street
Los Angeles 13, California

INSPECTOR'S REPORT

On June 27, 1960, Inspector John Smedley reported the excessive smoke was being emitted from an oil fired boiler located on the above premises owned and operated by the above corporation. Mr. Morgan Smokley advised the inspector that he was employed by the corporation as Engineer and Fireman, and that he comes on duty at 12:30 pm, and that he regularly had to readjust the boiler controls to maintain a proper fuel air ratio, and that the equipment was old and had to be watched constantly.

Upon completion of his observation, the Inspector issued a notice charging a violation of Section 24242 of the Health and Safety Code of the State of California to the corporation through Mr. L. E. Read, General Manager, who confirmed that Mr. Smokley was employed by the corporation and stated that he did not know how the boiler could have smoked.

APPROVED LLOYD H. MC EWEN, DIRECTOR OF ENFORCEMENT

RECOMMENDED HOWARD L. CLARK, CHIEF ENGINEERING INSPECTOR

JBM:un
6-28-60

16-40078

Figure VI-11. The Misdemeanor Complaint is filed with the jurisdictional court.

the point of observation, weather, wind, etc. The request will also contain a list of the physical evidence and photographs.

The section of the "Request" which is used to abstract the Inspector's report is written in firm and concise language, relating only to the facts of the prima facie case. The names of the witnesses, usually the inspectors involved, are included.

The Request for Complaint is then forwarded by the Investigator to the Director of Enforcement for signature. The Request for Complaint is delivered to the prosecuting attorney, who prepares a Misdemeanor Complaint (Figure VI-11) for filing in the appropriate court. The original copy of the Request for Complaint is delivered to the court where the Request is filed. The court then places the case on a calendar for arraignment. If, at the arraignment, a not guilty plea is entered, the trial date is set.

3. Conduct of the Court Trial

Should any action taken by the inspector in the field result in legal action and a plea of "not guilty" is entered during the arraignment, then the inspector will receive a subpoena or will be instructed to appear as one of the witnesses in the court trial.

When the inspector is called upon to testify, the prosecuting attorney, if he desires to do so, will attempt to establish his competence as a witness to testify on the matter before the court. The defense attorney, if not satisfied, may examine the witness himself on *Voir Dire*. Voir Dire is accomplished by inquiring into the background and qualification of the witnesses answering the questions.

All air pollution inspectors are qualified to testify on nearly all of the facts of the violations they observe by virtue of their in-service and smoke school training. However, the greater the technical training related to air pollution problems the inspector has received either from previous employment or formal education, the more his testimony will be accepted as evidence. In complex air pollution problems, expert testimony may be required to substantiate the identity and the chemical constituents of any air contaminants and the physical and chemical causes of pollution. If the inspector's qualifications are limited, he may not be permitted to testify on such crucial matters. In these cases expert testimony is given by District staff members who have specialized in technical fields related to the type of air pollution problem under question.

In the examination on Voir Dire, the inspector is usually required to answer the following:

1. His name, title and place and length of employment.
2. His duties as an air pollution inspector. The following is a condensed version of a hypothetical answer:

   Question: What are the duties of an Air Pollution Control Inspector?

   Answer: To patrol an assigned area and to observe, investigate and report on violations of the Health and Safety Code of the State of California and the Rules and Regulations of the Air Pollution Control District.

   To interview complainants and to investigate the sources complained of.

   To inspect equipment relative to compliance with existing law.

   To consult with representatives of business and industry in an effort to assist in constructive operational methods of controlling air pollution.

   To assist in certain source tests and to perform such other duties as are assigned by a supervisor.
3. Previous employment and educational experience. Degrees awarded, nature of courses.
4. Length and nature of in-service training.
5. Smoke School training.
   a. Number of times attended.
   b. Smoke School proficiency (does the inspector read within a 10% opacity or ½ Ringelmann Density accuracy?) (See Chapter 10.)
   c. Methods of smoke readings. Generally speaking, both the defense and prosecuting attorney will attempt to establish the inspector's ability to determine a violation of the law. In most cases the validity of the inspector's testimony will depend on his knowledge of the laws and, particularly, of the principles of reading air contaminants in terms of the Ringelmann Chart or smoke opacity. (See Chapter 10.)
6. Training with qualified inspectors and Senior Inspectors in the field.
7. Number of smoke readings in the field since graduation from smoke school.

Next, the inspector is examined for any other facts pertinent to the case. The inspector is generally prepared to testify as accurately as possible from memory. If he cannot, he requests permission from the court to refresh his memory from his reports. If he testifies on the basis of his reports, he can be cross-examined on any portion of them. In general, the line of questioning taken will be similar to the following:

1:* On date and location, were you on duty as inspector?
2. What directed your attention to this location?
3. Where were you when you first saw it?
4. Could you determine the source of emission?
5. Describe the premises.

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* These questions are for smoke from incinerators and open fires, usually the simplest types of air pollution cases.

6. Did you make any readings? What time commenced? What time concluded? How far from source? Ringelmann number or opacity?
   a. What was the length of the plume after recorded observation?
   b. Weather and lighting conditions.
7. Did you see what was in the source of the smoke?
8. Any conversation? with defendant? with employee? (With tenants in apartment house or similar premises?)
9. Introduce Ringelmann Chart into evidence. (By reference.)
10. Testimony or stipulations re ownership and/or agency.

B. *Hearing Board Cases**

The nature and function of the Air Pollution Control Hearing Board was previously described in Chapter 3.

The Hearing Board is concerned only with permit and variance cases. It is approached by means of a formal petition either from citizens appealing a decision of the Air Pollution Control District, or by the Air Pollution Control District itself when it seeks a revocation of a permit or a revocation or modification of a variance. The petitition is prepared to provide the Hearing Board with all of the facts necessary to render a decision in terms of the standards prescribed by the State Health and Safety Code. When requests for hearings are granted, witnesses are subpoenaed before the Board in the same manner as in a civil action. The procedures for qualifying witnesses and delivering testimony are similar to those in a court of law. There are some exceptions, however, particularly with reference to the admissibility of hearsay evidence. For this reason, Rule 86 below is quoted in full.

> Rule 86. EVIDENCE
>
> a. Oral evidence shall be taken on oath or affirmation.
>
> b. Each party shall have these rights: to call and examine witnesses; to introduce exhibits, to cross-examine opposing witnesses on any matter relevant to the issues even though that matter was not covered in the direct examination; to impeach any witness regardless of which party first called him to testify; and to rebut the evidence against him. If respondent does not testify in his own behalf he may be called and examined as if under cross-examination.
>
> c. The hearing will not be conducted according to technical rules relating to evidence and witness. Any relevant evidence shall be admitted if it is the sort of evidence on which responsible persons are accustomed to rely in the conduct of serious affairs, regardless of the existence of any common law or statutory rule which might make improper the admission of such evidence over objection in civil actions. Hearsay evidence may be used for the purpose of supplementing or explaining any direct evidence but shall not be sufficient in itself to support a finding unless it would be admissible over objections in civil actions. The rules of privilege shall be effective to the same extent that they are now or hereafter may be recognized in civil actions, and irrelevant and unduly repetitious evidence shall be excluded.

1. Variances

In some cases where individuals or companies cannot conduct their businesses without undue hardship, or where business activity might be completely suspended as a result of compliance with any of the prohibitions of the State Health and Safety Code, the Hearing Board may hear such cases and deny or grant variances of the rule or code section involved under prescribed conditions. The variances are granted or denied strictly in terms of the conditions set forth in Section 24296 of the Health and Safety Code as follows:

> SECTION 24296. If the Hearing Board finds that because of conditions beyond control compliance with Article 3 of this chapter or with any rule, regulation, or order of the Air Pollution Control Board will result in an arbitrary and unreasonable taking of property or in the practical closing and elimination of any lawful business, occupation or activity, in either case without a sufficient corresponding benefit or advantage to the people in the reduction of air contamination, it shall prescribe other and different requirements not more onerous applicable to plants and equipment operated either by named classes of industries or persons, or to the operation of separate persons; provided, however, that no variance may permit or authorize the maintenance of a nuisance.

Variances granted by the Hearing Board are usually expressed in terms of limitations and conditions. For example, the Hearing Board may determine that in order for a person to operate his equipment within the law, he will require a certain period of time to correct his air pollution problem. In the time period allowed, he may be permitted to operate the equipment, and the standard of the Rule in question is modified in his case to permit those quantities of air pollutants which cannot be avoided in the most careful operation of the equipment. The standard of permissibility may be raised — contaminants may be permitted to be emitted at a rate, for example, of 60% opacity for periods totaling not more than 6 minutes in any one hour, instead of 39% for periods not totaling more than 3 minutes in any one hour. The Hearing Board may also stipulate certain operating conditions which must be complied with.

When the written decision is handed down by the Hearing Board, abstracts of the variance conditions and limitations are made on the form shown in Figure VI-12 and are distributed to all District personnel concerned. One copy of the abstract of the variance is also sent to the APCD Communications Center, in order that all claims regarding the possession of variances made by persons in the field can be instantly verified by radio. The Sector Engineering Inspector also receives a copy and immediately inspects the plant to determine if the operator is in compliance with the conditions of the variance. If non-compliance of conditions is observed, the inspector can initiate legal action in the same manner as any other violation. The facts of the case, however, are noted on an Inspector's Field Report rather than on a written Notice of Violation.

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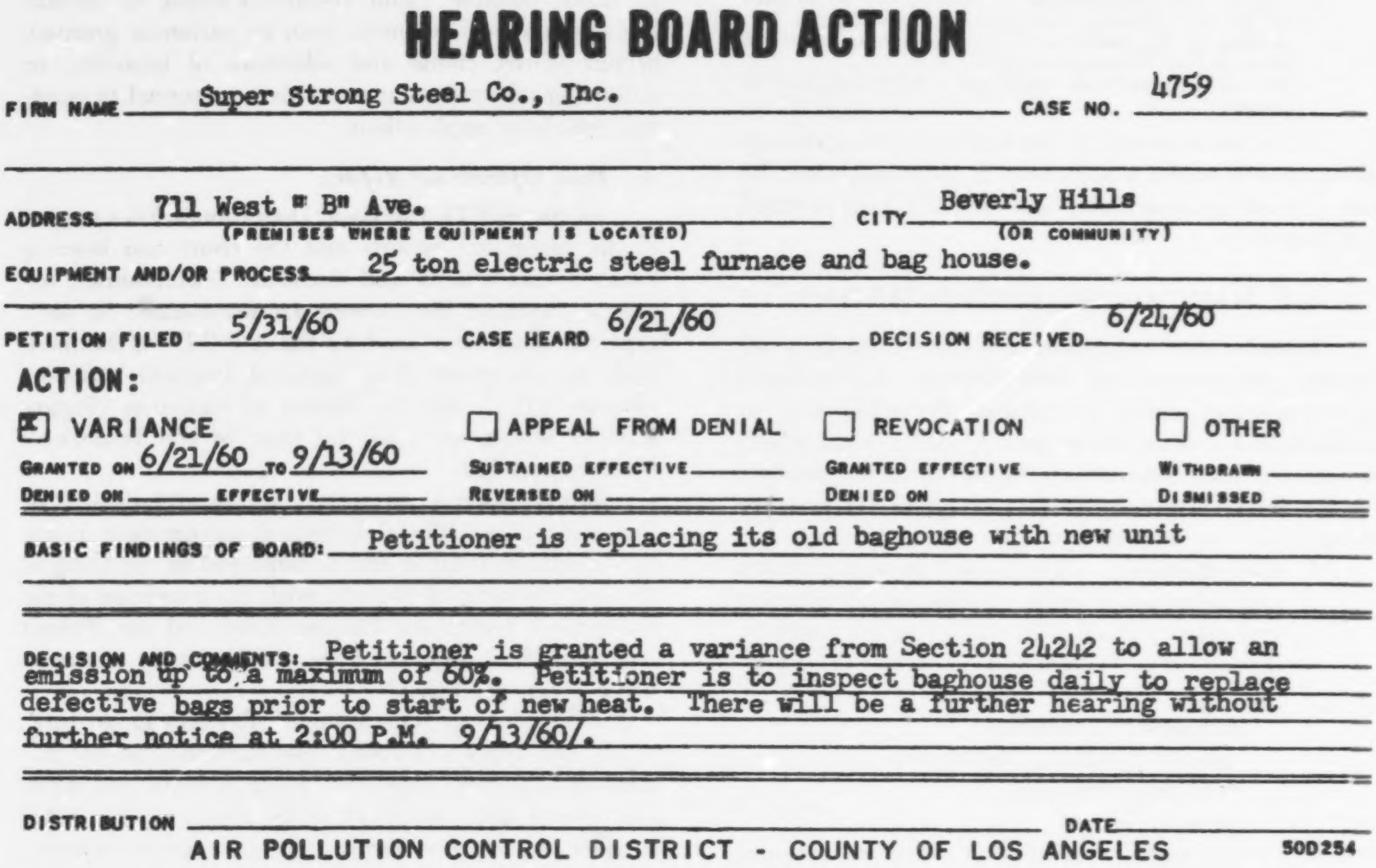
* Although this activity is now supervised by the A.P.C.D. Engineering Division, it is included here as an enforcement concept.



HEARING BOARD ACTION

FIRM NAME Super Strong Steel Co., Inc. CASE NO. 4759

ADDRESS 711 West " B" Ave. (PREMISES WHERE EQUIPMENT IS LOCATED) CITY Beverly Hills (OR COMMUNITY)

EQUIPMENT AND/OR PROCESS 25 ton electric steel furnace and bag house.

PETITION FILED 5/31/60 CASE HEARD 6/21/60 DECISION RECEIVED 6/24/60

ACTION:

☒ VARIANCE ☐ APPEAL FROM DENIAL ☐ REVOCATION ☐ OTHER

GRANTED ON 6/21/60 TO 9/13/60 SUSTAINED EFFECTIVE ___ GRANTED EFFECTIVE ___ WITHDRAWN ___

DENIED ON ___ EFFECTIVE ___ REVERSED ON ___ DENIED ON ___ DISMISSED ___

BASIC FINDINGS OF BOARD: Petitioner is replacing its old baghouse with new unit

DECISION AND COMMENTS: Petitioner is granted a variance from Section 24242 to allow an emission up to a maximum of 60%. Petitioner is to inspect baghouse daily to replace defective bags prior to start of new heat. There will be a further hearing without further notice at 2:00 P.M. 9/13/60/.

DISTRIBUTION ___ DATE ___

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES 50D254

Figure VI - 12. Memo of abstract of Hearing Board variance distributed to all concerned A.P.C.D. personnel.

2. Appeal from Denial of Operating Permit and Authority to Construct

Under the permit system, application must be made to the District for an authority to construct and a permit to operate equipment capable of emitting air contaminants. If the application submitted by the applicant is approved by the Engineering Division of the APCD, a permit is issued. If the application is denied, then a letter of denial is sent to the applicant. The applicant may then, if he desires, petition the Hearing Board to review the denial. The petition must be filed by the applicant within 10 days after receipt of the denial. When the public hearing is held, the Hearing Board examines all of the data concerned and will either sustain the District's denial, grant an operating permit, or state conditions which must be complied with before a permit will be granted.

When the denial is issued, the inspector receives a denial check slip to inspect the equipment involved and determine the status of compliance or non-compliance with the denial. Non-compliance with the denial is a violation of Section 24279.

3. Revocation and Suspension of Permits

Whenever equipment which has been granted a permit either by reason of compliance with the provisions of Rule 10, *Permits Required*, or by reason of Rule 13, *Blanket permits*, develops a chronic history of non-compliance with other rules or code sections, the Air Pollution Control Officer may petition the Hearing Board for a revocation of the permit. According to Section 24276 of the State Health and Safety Code, an existing permit is revoked if the Hearing Board finds:

1. The permittee has failed to correct any conditions required by the Air Pollution Control Officer, or
2. A refusal of a permit would be justified, or,
3. Fraud or deceit was employed in the obtaining of a permit, or
4. Any violation of this chapter or of any Rule or Regulation of the Air Pollution Control Board.

Permits may also be suspended by the Air Pollution Control District if the permittee fails to furnish the APCD with information, analyses, plans or specifications. If the permit is suspended, the permittee may petition the Hearing Board for a public hearing to determine whether or not the permit was properly suspended. The Hearing Board, accordingly, may reinstate the permit, sustain the suspension, or set forth conditions which must be met before reinstatement is granted. The Air Pollution Control Officer may reinstate a suspended permit on his own discretion.

SECTION 24276. After a public hearing, the Hearing Board may:

a. Continue the suspension of a permit suspended by the Air Pollution Control Officer, or

b. Remove the suspension of an existing permit invoked by the Air Pollution Control Officer pending the furnishing by the permittee of the information, analysis, plans and specifications required, or

c. Find that no violation exists and reinstate an existing permit.

When an inspector in the field observes operation of equipment under a suspended or revoked permit, he can take such action under Section 24278 as is outlined in Chapter 13.

VII MAINTAINING RECORD SYSTEMS

In order that maximum use can be made of all reports generated from field activity, a functional record-keeping system is required. Record-keeping in enforcement is intended to provide information which is actively and continuously employed in the conduct of the field control operations program. There are three basic uses required of such record systems.

1. *Case Histories* — The record system provides case histories of prior compliance or violation and other factual information which could be submitted as evidence in a court of law, such as:
    - frequency of violation
    - causes of pollution problems
    - pollution potentials
    - process flows
    - equipment maintenance and operational practices
    - permit status
    - products manufactured.
2. *Monitor Operations* — The record system should provide a record of field and administrative practices in order that all phases of the inspection and enforcement program may be monitored. Record-keeping discloses the judgments and decisions made in each operational step and at each level of responsibility in completing an enforcement action.
3. *Statistical Analyses* — The record system should provide valid statistical summarizations and analyses of the results of the program for evaluating progress made, pollution potentials, and in preparing budgets and determining personnel needs.

To fulfill these requirements, it is necessary to develop filing systems which make available any information which may be required. In the APCD, two general filing systems are employed, the (1) *Basic Operational Files* consisting of the original field reports made by inspectors, and the decisions and dispositions handed down from the courts and the Hearing Board. and (2) the *Administrative* or *Secondary Operational Files* consisting of data summarized or abstracted from the basic reports for analyses, classification, or quick-finding reference. Other filing systems are used for expedience in highly functional or specialized situations. These are "dispatch" or "suspense" files set up to make possible rapid communications of certain information to field units, such as variances granted, permit status, name and addresses of locations, or chronological systems used to alert personnel to pending reports or applications.

A. Basic Operational Reports

In the APCD, the Basic Operational Files consist of the inspection reports and the court and hearing board dispositions and decisions (enforcement actions). Separate file drawers are maintained for each type of report form used by the APCD in the field, with the exception of the general Inspector's Report (Figure VII-7) and the Notice of Violation (Figure XIII-1) which are filed together in the Inspector's Field Report File.

Filing systems are either of the alphabetical or numerical types. The alphabetical arrangement makes for direct accessibility and is employed in the filing of all basic operational reports, with the exception of the Equipment Inventory Dossier Files and the Permit Applications and Permit Files which employ a numerical system (see below).

Numerical systems used by the APCD, in turn, are of two types (1) coded classification, and (2) numerical sequence. The first system is employed when the type of data contained in the report is of a statistical or descriptive nature (see *descriptive reports*) and readily breaks down into a logical classification system. The grouping of the records themselves into the categories and classifications directly yields up-to-date statistical information. A coded classification system of this nature can be applied with great advantage to inventory records (Equipment Lists) to break inventories down into industrial activities (refinery and petrochemical, metal melting, power plants, etc.). The APCD files Equipment Lists according to a Primary and Secondary Industrial Activity Classification System (see Table XIV-1).

The Numerical Sequence System is employed when a strict accounting is required of all legal documents issued or processed such as those involved in permit applications and permits to operate. The numerical system not only serves to register the sources of air pollution in the order of the receipt of application, but provides running totals of such applications received and permits granted.

With both systems, however, an alphabetical cross-index card or visible file system will be required for reference finding.

Secondary operational files comprise the records and reports used to evaluate the progress of any general or detailed phase of the inspection and enforcement program, and are obtained from such analytical operations performed on the basic files as classifying, abstracting, condensing, summarizing or recombining data in new forms. For example, the APCD may require from time to time the following kinds of information: the number and identity of all oil-fired brass furnaces in a certain sector, the number of electrical precipitators in the entire pollution zone, the number of court cases involved in a dust-nuisance problem, and other similar types of information.

Figure VI-13. Punch card and key sorting files for selectively recording and locating enforcement data.

B. Administrative or Secondary Operational Files

There are four types of secondary filing systems employed by the A.P.C.D. These are as follows:

1. The Master Control Record System — Selective Analysis

The Master Control Record System is a means of posting on a single card all of the key findings and dispositions obtained from the basic operational reports for a single plant location. The data is supplied to the card in two ways: first, by code punching the rim or periphery of the card, permitting subsequent analysis by key sorting, and, second, by posting of information in writing in the classified columns on the interior of the card. The coded punch data represents the classification of data most desired for analyses, while the written information provides more detailed, explanatory material.

Ideally, it may be desired to combine all data on one Master Card. In actual practice, however, more than one Master Record System may be required. In the District, two such Master Record Systems are used, the (1) Violation Record (Figure VI-14) and the (2) Equipment Inventory Master Record (Figure VI-15).

a. The Equipment Inventory Master Record

This card is used for the posting of data selected from the Equipment Lists and Activity Status Reports and is used to determine the number and identity of plants existing in any of the following categories.

Type of basic contaminant emitted (smoke, dust. fumes, etc.)
Type of control used (cyclone, precipitator, scrubber, etc.)
Month reinspection due
Primary and secondary activity classifications
Frequency of inspection.

Additional information is recorded in writing in the appropriate blank spaces. This includes data of last complete reinspection, nature of ownership (corporation, partnership, individual, etc.), time factor unit (time taken to complete previous inspections) and general Hearing Board disposition (Figure VI-12).

These cards are then filed in special drawers by inspection sector, and then alphabetically by company.

b. Violation Record

The Violation Record is intended primarily to provide statistical information with respect to the types of violations and the disposition of court and hearing board cases. The system is also intended to provide ready cross-reference between company names and individual defendants and co-defendants. The card records the following punched coded information:

Map grid, coordinates of source
Time of Violation (year, month, day and time)
Inspection sector
Rule or State Code Section violated
Type of Equipment source
Disposition of court and Hearing Board cases.

The names of co-defendants, affiliates and other detailed administrative data are written in the appropriate blank spaces on the card.(See Figure VI-14). One violation card is made out for each specific violation or Hearing Board case, and all violations are listed on the Master Inventory Card in order of occurrence.

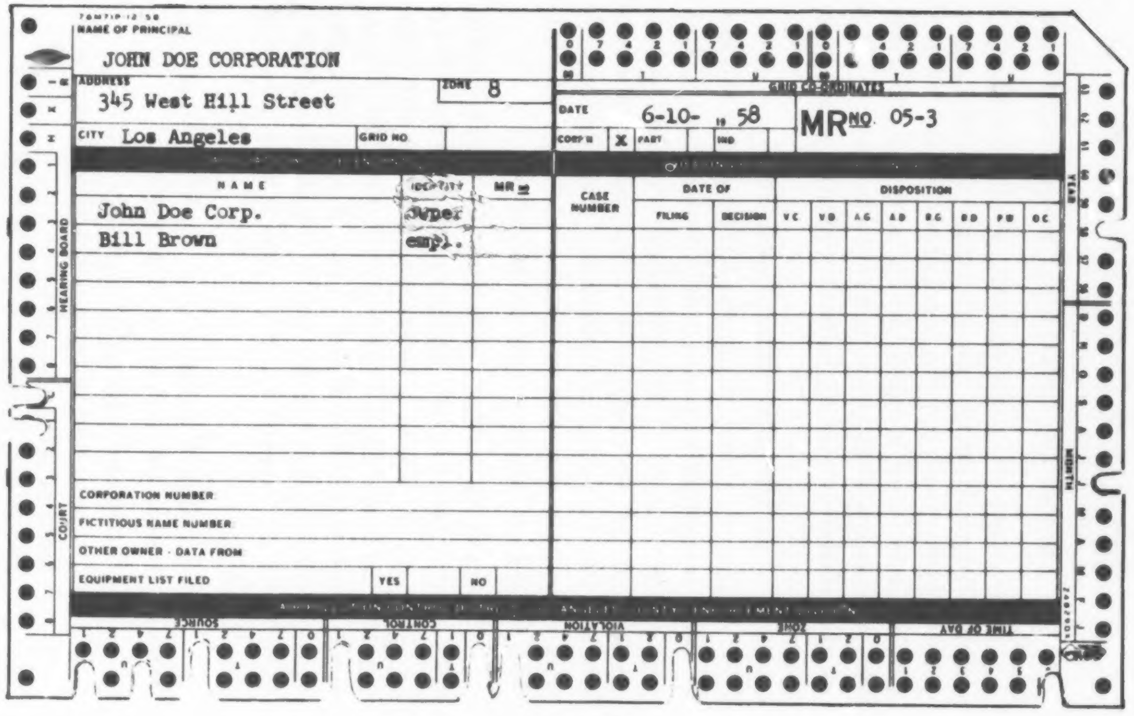
2. Quick-Reference Visible Files

As may be noted, the administrative files just discussed are maintained in a numerical system. Thus. the Master Record of an individual company cannot be located by its name. An alphabetical reference *finding file* is therefore required. This finding file should contain just the essential finding information and should be easily consulted and revised.

To meet this need, alphabetical visible finding files are employed by the Enforcement Division. These are used primarily as a reference to locate either the Equipment Lists, or the Sectors by which the Master Record cards can be located. Two of such files complement the Equipment Inventory Master Record and the Violation Record Cards, respectively (see Figure VI-16).

The Finding Reference File for Equipment Inventory records the following information.

Name and address of company
Primary and secondary activity classification
Date of last inspection
Inspection Sector


GRID CO-ORDINATES
YEAR
MONTH
HEARING BOARD
COURT
SOURCE
CONTROL
VIOLATION
ZONE
TIME OF DAY

NAME OF PRINCIPAL JOHN DOE CORPORATION

ADDRESS 345 West Hill Street ZONE 8

CITY Los Angeles GRID NO

DATE 6-10- 19 58 MR NO. 05-3

CORP'N X PART IND

NAME	IDENTITY	MR NO	CASE NUMBER	DATE OF FILING	DATE OF DECISION	VC	VD	AG	AD	BG	BD	PD	OC
John Doe Corp.	Super												
Bill Brown	empl.												

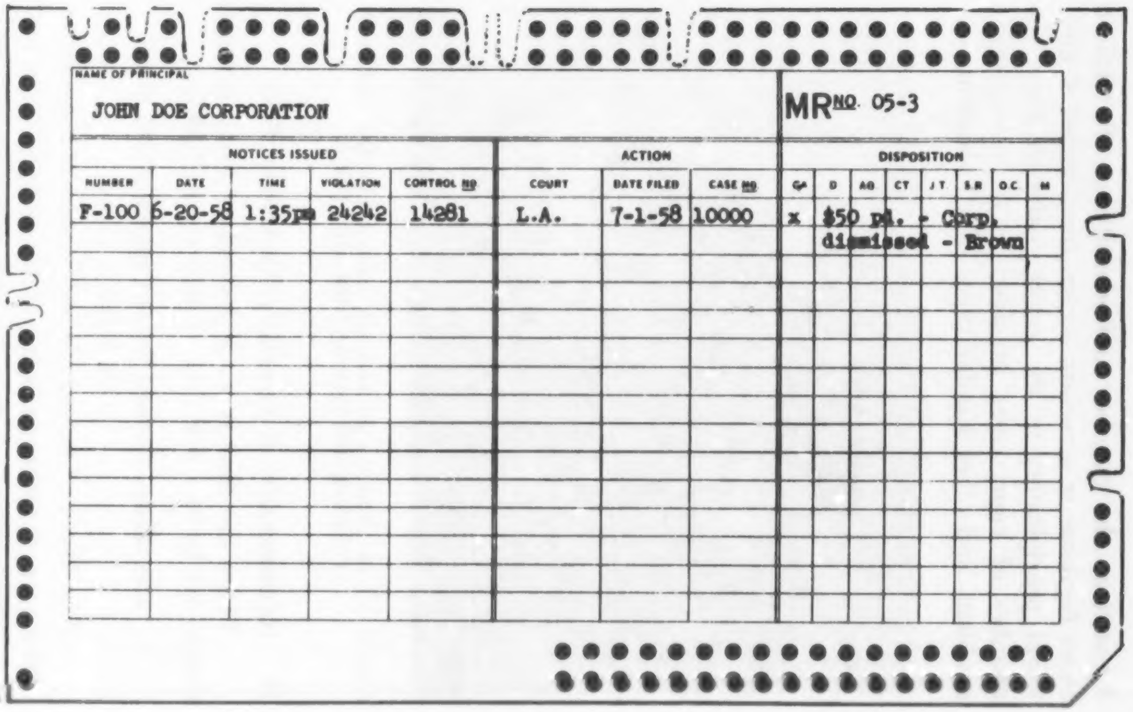
CORPORATION NUMBER

FICTITIOUS NAME NUMBER

OTHER OWNER - DATA FROM

EQUIPMENT LIST FILED YES NO

(Front)



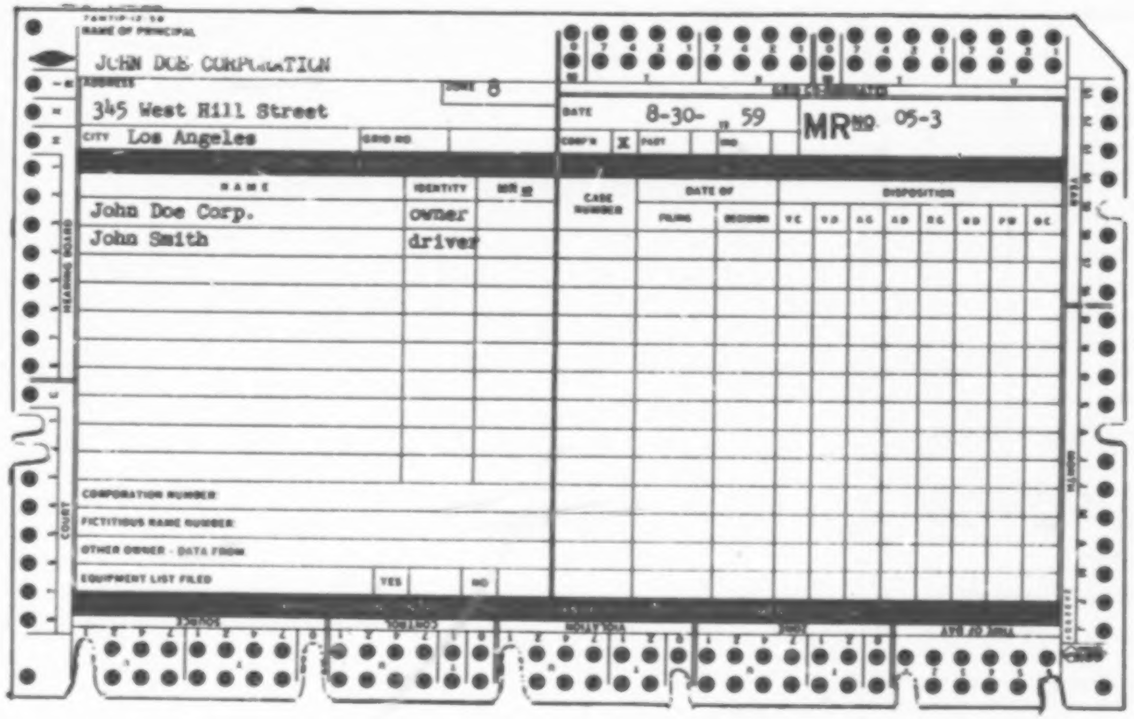
NAME OF PRINCIPAL JOHN DOE CORPORATION

MR NO. 05-3

NOTICES ISSUED NUMBER	DATE	TIME	VIOLATION	CONTROL NO	ACTION COURT	DATE FILED	CASE NO	DISPOSITION G/P	D	AG	CT	JT	SR	OC	M
F-100	6-20-58	1:35pm	24242	14281	L.A.	7-1-58	10000	x	$50 pd. - Corp. dismissed - Brown						

(Back)

Figure VI - 14. VIOLATION RECORD CARD #1. The data on the above card reports that the John Doe Corporation, a brass foundry (the industrial activity can be decoded from Table XIV - 1), at the address shown on the card, and an employee, Bill Brown, were charged with a violation of Sec. 24242 of the Health and Safety Code from a baghouse on a metallurgical furnace (note "source" and "control" punching) on June 20, 1958 between 12 Noon and 2:00 p.m. A guilty plea was entered and the court case was completed. The backside shows the data relating to the processing of the case in court. The corporation was found guilty and fined $50. The charge against Brown, the operator, was dismissed.



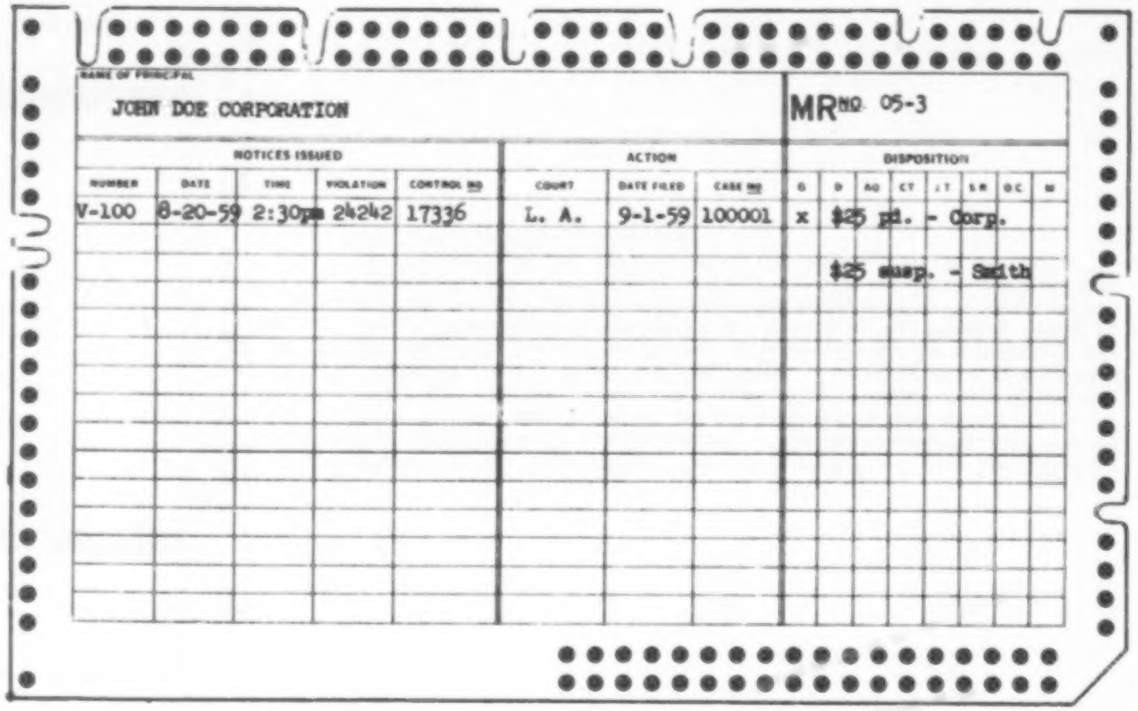
NAME OF PRINCIPAL
JOHN DOE CORPORATION
ADDRESS 345 West Hill Street ZONE 8
CITY Los Angeles GRID NO
DATE 8-30- 19 59
CORP'N X PART IND
MR NO. 05-3

NAME	IDENTITY	MR NO
John Doe Corp.	owner	
John Smith	driver	

CORPORATION NUMBER
FICTITIOUS NAME NUMBER
OTHER OWNER - DATA FROM
EQUIPMENT LIST FILED YES NO

HEARING BOARD
COURT
CASE NUMBER
DATE OF
FILING
DECISION
DISPOSITION
YEAR
MONTH

(Front)



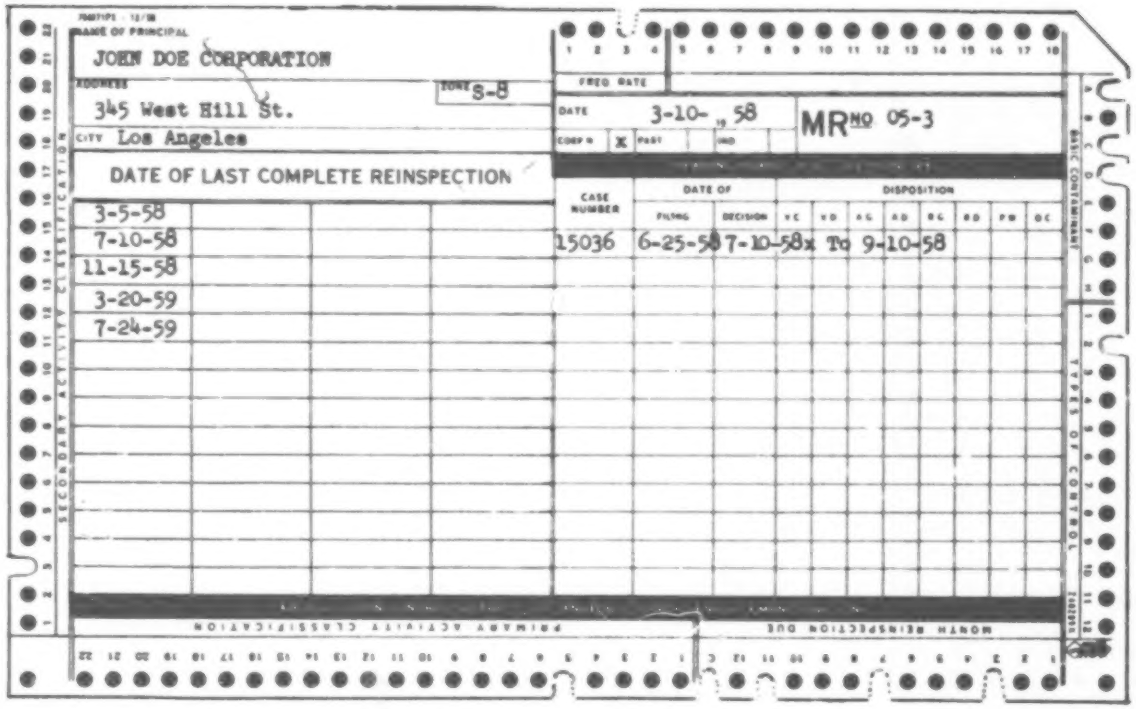
NAME OF PRINCIPAL
JOHN DOE CORPORATION
MR NO. 05-3

NOTICES ISSUED					ACTION			DISPOSITION							
NUMBER	DATE	TIME	VIOLATION	CONTROL NO	COURT	DATE FILED	CASE NO	G	D	AG	CT	JT	SR	OC	M
V-100	8-20-59	2:30pm	24242	17336	L. A.	9-1-59	100001	x	$25 pd. - Corp.						
									$25 susp. - Smith						

B

(Back)

Figure VI-14.1 VIOLATION RECORD CARD #2. The John Doe Corporation and its driver, John Smith, are charged with a Section 24242 (smoke opacity) violation from a company truck on August 20, 1959, between 2:00 and 4:00 p.m. (7). The case was submitted on report (1 and 2) and both defendant and codefendant were found guilty and were sentenced $25. Smith's sentence was suspended, however.


BASIC CONTAMINANT
TYPES OF CONTROL
PRIMARY ACTIVITY CLASSIFICATION
SECONDARY ACTIVITY CLASSIFICATION
MONTH REINSPECTION DUE
FREQ. RATE

NAME OF PRINCIPAL JOHN DOE CORPORATION

ADDRESS 345 West Hill St. ZONE S-8

CITY Los Angeles

DATE 3-10-, 19 58

MR NO. 05-3

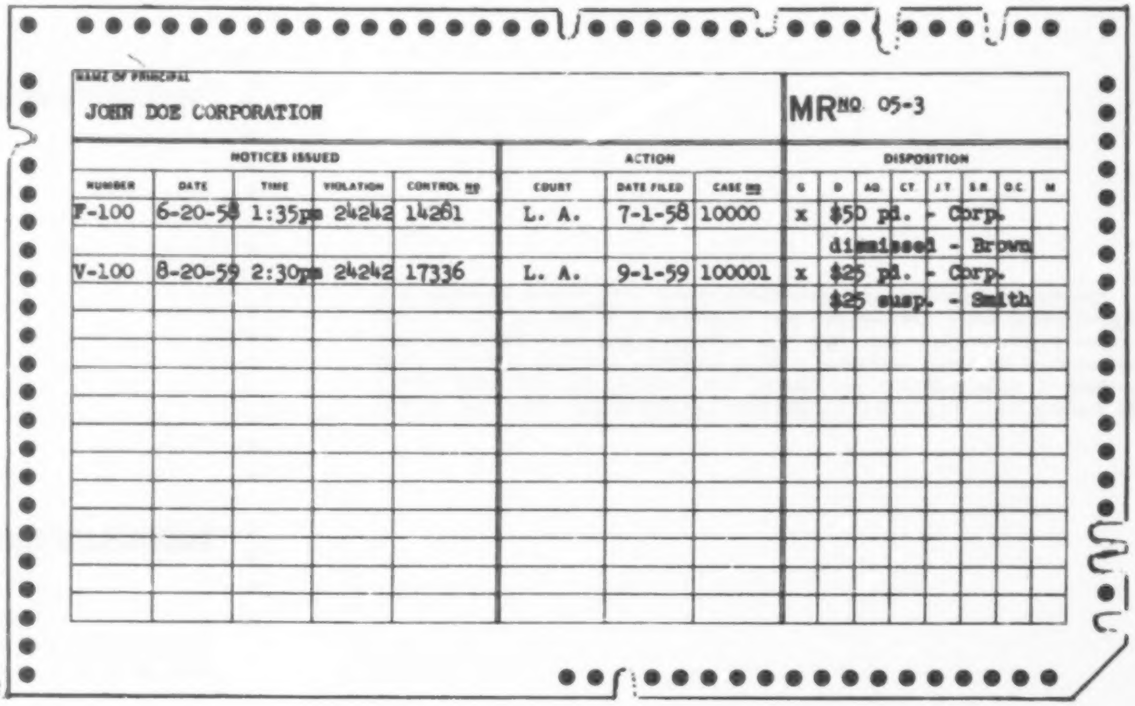
CORP'N X

DATE OF LAST COMPLETE REINSPECTION

3-5-58			
7-10-58			
11-15-58			
3-20-59			
7-24-59			

CASE NUMBER	DATE OF FILING	DATE OF DECISION	VC	VD	AG	AD	BC	BD	PM	OC
15036	6-25-58	7-10-58	x	To 9-10-58						

(Front)



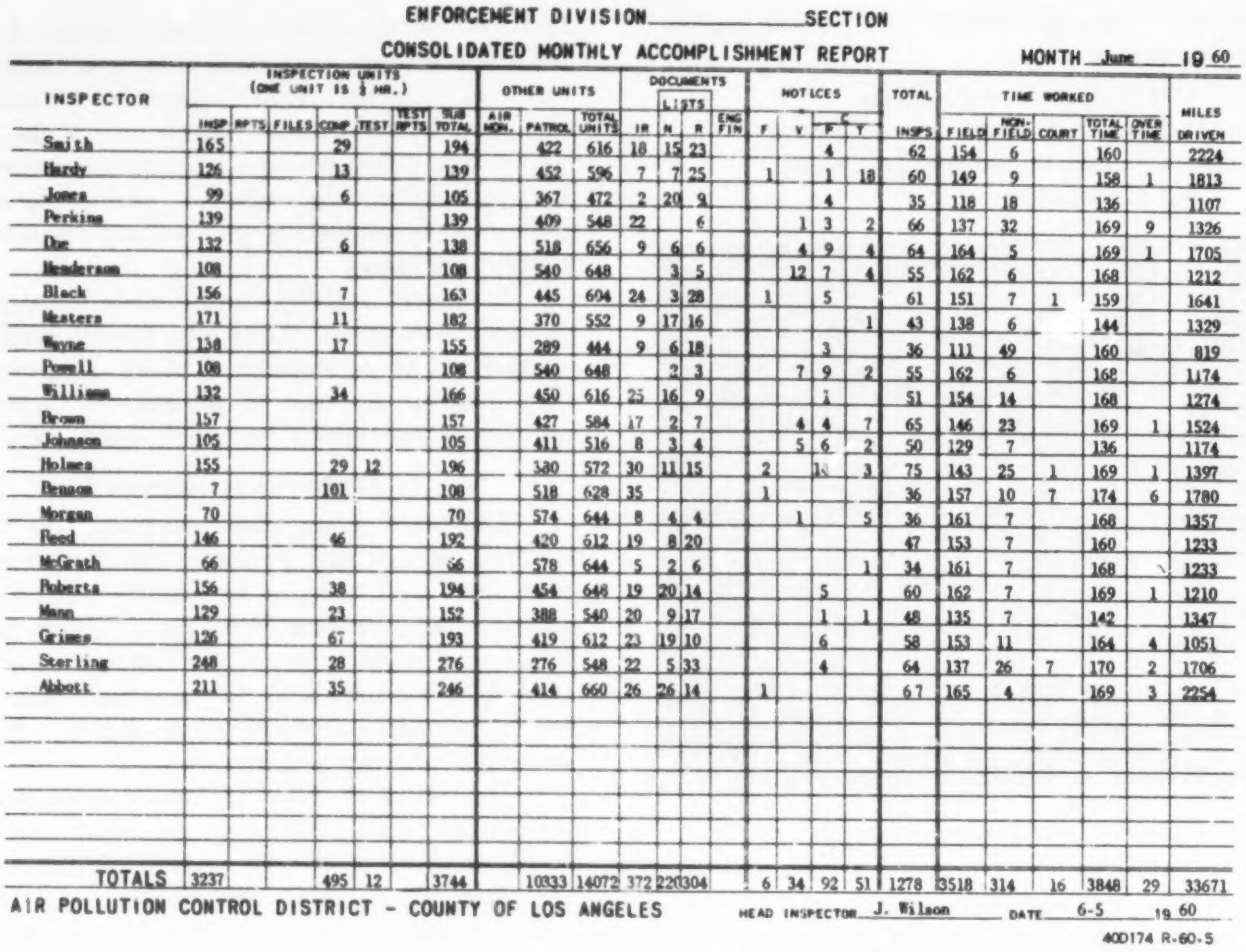
NAME OF PRINCIPAL JOHN DOE CORPORATION

MR NO. 05-3

NOTICES ISSUED					ACTION			DISPOSITION							
NUMBER	DATE	TIME	VIOLATION	CONTROL NO.	COURT	DATE FILED	CASE NO.	G	D	AG	CT	JT	SR	OC	M
F-100	6-20-58	1:35pm	24242	14261	L. A.	7-1-58	10000	x	$50 pd. - Corp.						
									dismissed - Brown						
V-100	8-20-59	2:30pm	24242	17336	L. A.	9-1-59	100001	x	$25 pd. - Corp.						
									$25 susp. - Smith						

(Back)

Figure VI-15. This Master Control Record Card classifies the John Doe Corporation as a brass foundry. The basic contaminants emitted from its activities are smoke and combustion products, solid particulates (dust and aerosols), gases and vapors. The principal types of controls employed are dry filters, e.g., baghouses. The corporation is scheduled for inspection three times a year, and has already been inspected five times. The company applied for a variance at the Hearing Board on 7-10-58, presumably to install improved equipment or to make modifications or repairs in order to achieve compliance. Note also that both the stationary and moving violations are recorded on the reverse of the Master Control Equipment Card.



ENFORCEMENT DIVISION ____________ SECTION

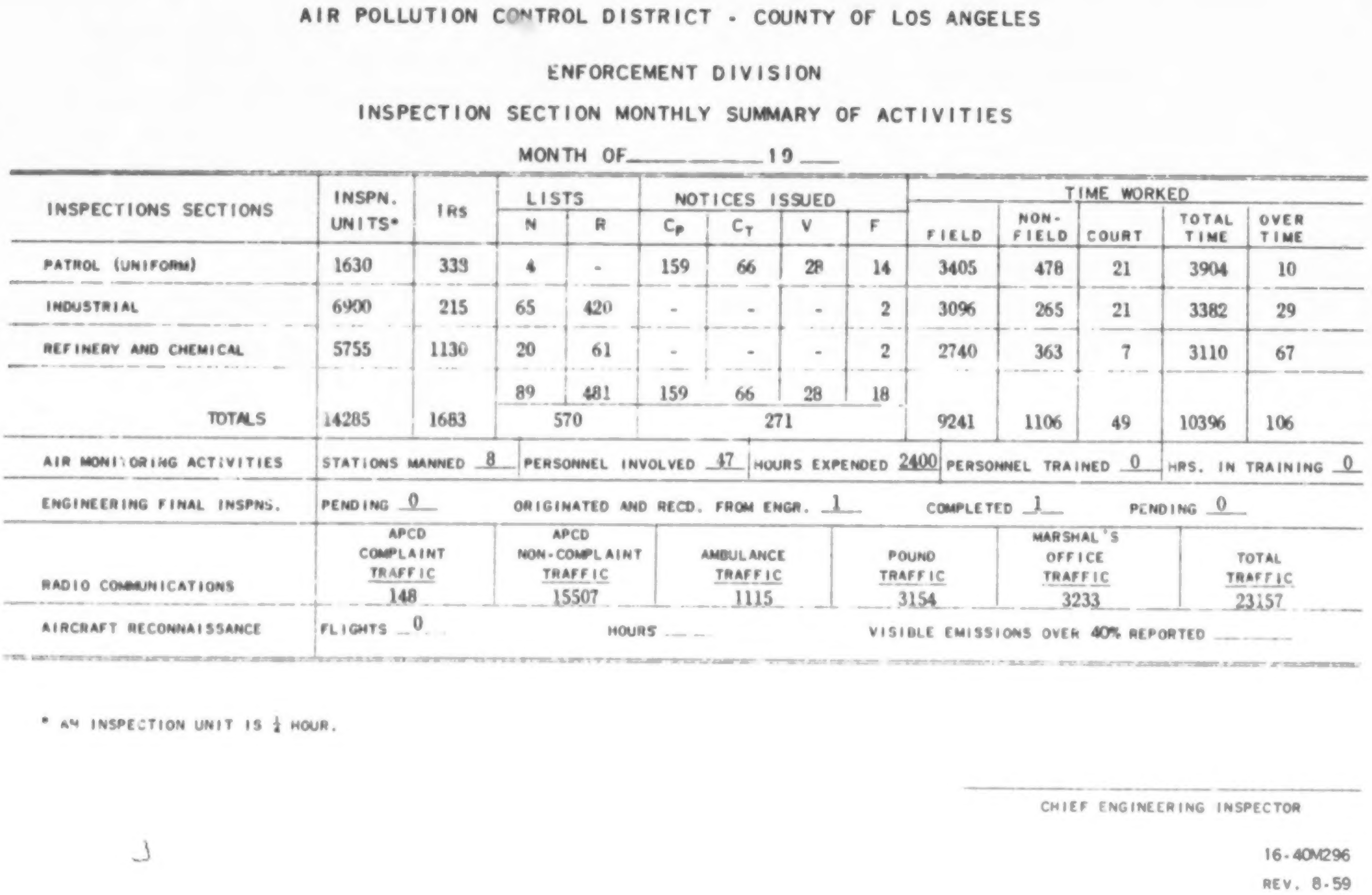
CONSOLIDATED MONTHLY ACCOMPLISHMENT REPORT MONTH June 19 60

INSPECTOR	INSPECTION UNITS (ONE UNIT IS ½ HR.)							OTHER UNITS			DOCUMENTS				NOTICES				TOTAL	TIME WORKED					MILES
												LISTS					C								
	INSP	RPTS	FILES	COMP	TEST	TEST RPTS	SUB TOTAL	AIR MON.	PATROL	TOTAL UNITS	IR	N	R	ENG FIN	F	V	P	T	INSPS	FIELD	NON-FIELD	COURT	TOTAL TIME	OVER TIME	DRIVEN
Smith	165			29			194		422	616	18	15	23				4		62	154	6		160		2224
Hardy	126			13			139		452	596	7	7	25		1		1	18	60	149	9		158	1	1813
Jones	99			6			105		367	472	2	20	9				4		35	118	18		136		1107
Perkins	139						139		409	548	22		6			1	3	2	66	137	32		169	9	1326
Doe	132			6			138		518	656	9	6	6			4	9	4	64	164	5		169	1	1705
Henderson	108						108		540	648		3	5			12	7	4	55	162	6		168		1212
Black	156			7			163		445	604	24	3	28		1		5		61	151	7	1	159		1641
Masters	171			11			182		370	552	9	17	16					1	43	138	6		144		1329
Wayne	138			17			155		289	444	9	6	18				3		36	111	49		160		819
Powell	108						108		540	648		2	3			7	9	2	55	162	6		168		1174
Williams	132			34			166		450	616	25	16	9				1		51	154	14		168		1274
Brown	157						157		427	584	17	2	7			4	4	7	65	146	23		169	1	1524
Johnson	105						105		411	516	8	3	4			5	6	2	50	129	7		136		1174
Holmes	155			29	12		196		330	572	30	11	15		2		10	3	75	143	25	1	169	1	1397
Benson	7			101			108		518	628	35				1				36	157	10	7	174	6	1780
Morgan	70						70		574	644	8	4	4			1		5	36	161	7		168		1357
Reed	146			46			192		420	612	19	8	20						47	153	7		160		1233
McGrath	66						66		578	644	5	2	6					1	34	161	7		168		1233
Roberts	156			38			194		454	648	19	20	14				5		60	162	7		169	1	1210
Mann	129			23			152		388	540	20	9	17				1	1	48	135	7		142		1347
Grimes	126			67			193		419	612	23	19	10				6		58	153	11		164	4	1051
Sterling	248			28			276		276	548	22	5	33				4		64	137	26	7	170	2	1706
Abbott	211			35			246		414	660	26	26	14		1				67	165	4		169	3	2254
TOTALS	3237			495	12		3744		10333	14072	372	220	304		6	34	92	51	1278	3518	314	16	3848	29	33671

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES HEAD INSPECTOR J. Wilson DATE 6-5 19 60

400174 R-60-5

Figure VI - 17. Inspector's Consolidated Monthly Report of Enforcement Activities.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES

ENFORCEMENT DIVISION

INSPECTION SECTION MONTHLY SUMMARY OF ACTIVITIES

MONTH OF ________ 19 ___

INSPECTIONS SECTIONS	INSPN. UNITS*	IRS	LISTS		NOTICES ISSUED				TIME WORKED				
			N	R	C_P	C_T	V	F	FIELD	NON-FIELD	COURT	TOTAL TIME	OVER TIME
PATROL (UNIFORM)	1630	333	4	-	159	66	28	14	3405	478	21	3904	10
INDUSTRIAL	6900	215	65	420	-	-	-	2	3096	265	21	3382	29
REFINERY AND CHEMICAL	5755	1130	20	61	-	-	-	2	2740	363	7	3110	67
			89	481	159	66	28	18					
TOTALS	14285	1683	570		271				9241	1106	49	10396	106

AIR MONITORING ACTIVITIES: STATIONS MANNED 8 | PERSONNEL INVOLVED 47 | HOURS EXPENDED 2400 | PERSONNEL TRAINED 0 | HRS. IN TRAINING 0

ENGINEERING FINAL INSPNS.: PENDING 0 ORIGINATED AND RECD. FROM ENGR. 1 COMPLETED 1 PENDING 0

RADIO COMMUNICATIONS	APCD COMPLAINT TRAFFIC	APCD NON-COMPLAINT TRAFFIC	AMBULANCE TRAFFIC	POUND TRAFFIC	MARSHAL'S OFFICE TRAFFIC	TOTAL TRAFFIC
	148	15507	1115	3154	3233	23157

AIRCRAFT RECONNAISSANCE: FLIGHTS 0 HOURS ___ VISIBLE EMISSIONS OVER 40% REPORTED ______

* AN INSPECTION UNIT IS ½ HOUR.

CHIEF ENGINEERING INSPECTOR

16-40M296
REV. 8-59

Figure VI - 18. Inspection Section Monthly Summary of Activities.

And the Violation Finding File records the following information:

Name and address of violator.
Citation and written notice number.
Driver's license and vehicle number.
Date of violation.

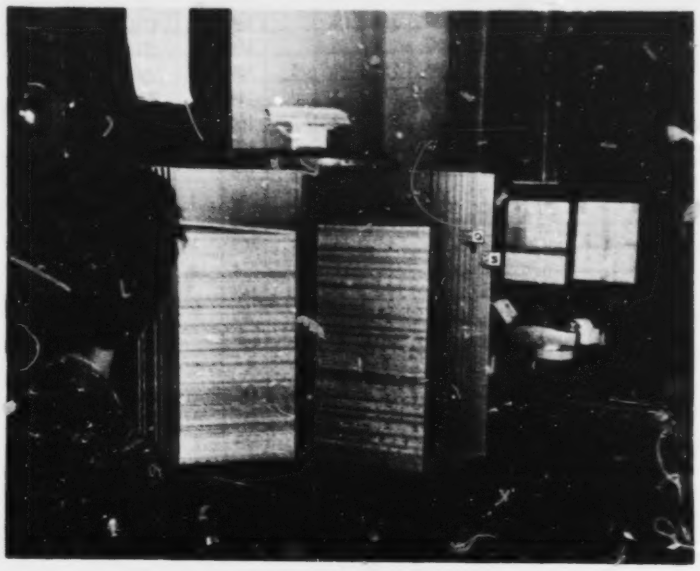


Figure VI - 16. Visible finding files.

3. Statistical Files

The basic and secondary operational files discussed so far are thus readily available for any number of uses which may be demanded of them. The uses take two forms, (1) summarization or reduction to manageable and meaningful entities, and (2) statistical analysis of any particular phase of the field control operations program.

Summarization involves periodically compiling such data as the number of inspections, number of written reports, the number and type of written notices issued, and the number of new and revised Equipment Lists. These results are compiled for each inspector on a Monthly Accomplishment Report. The totals of the inspection activities conducted by all of the inspectors are then computed on a Monthly Summary of Activities (See Figures VI-17 and VI-18). This data informs the command unit of the degree to which saturation coverage is being maintained, trends in compliance, the relative performance of the individual inspectors, inspection and enforcement intensity and scope.

Statistical analyses can be made for any number of specific purposes. Generally, it will involve either comparison or correlation of those categories of data contained on the rims of the Master Cards, or any other data which may be readily accessible.

4. Dispatch and Suspense Files

These are special files which may be located at strategic dispatching points in the Enforcement Division and are usually of the "visible" reference, log or journal entry, or card-filing types. Their purpose is to provide certain types of information which may be immediately required by field personnel. The information is generally dispatched on request of the field inspectors by radio or telephone.

The Dispatch Files include a constantly maintained visible file of current variances and reported breakdowns of equipment. Also included are: (1) a complaint log in which complaints are maintained in order of receipt, (2) a radio-telephone message log, which records chronologically the receipt and transmission of all messages in the APCD communications center, and (3) a radio-telephone message file, consisting of messages filed in order of receipt.

The various Inspection Sections maintain records and files required for their daily operations. These include source-testing files, permit logs, plant status cards, permit suspense files, and Engineering Field Report Assignment Logs.

REFERENCES

1. McEwen, Lloyd H., *Enforcement Division Annual Report*, Los Angeles County Air Pollution Control District, 41 pp., 1959-1960.

CHAPTER SEVEN

THE AIR POLLUTION INSPECTOR

An inspector, according to most dictionary definitions, is one who views or examines closely and critically as an official act or as part of a legal proceeding. He is often fictionally portrayed as being highly capable in detecting clues and perceiving motives. A more sophisticated conception characterizes him as a criminal psychologist. To some extent, this conception is true since there are many occasions in which the determining factor in taking enforcement action is the inspector's findings with respect to motive. However colorful some of these attributes are, inspectors from all branches of law enforcement must be analytical, critical and objective.

But, aside from these characteristics, inspectors differ substantially according to the services they perform. While all are concerned with the enforcement of the law, the means for obtaining compliance may differ considerably. The criminal investigator, for example, is only interested in a case when a crime is alleged to have been committed. The public health or safety inspector is concerned more with public practices with regard to health and safety standards. In public health programs, criminal prosecution plays an important, but not the primary role. Rather, inspectors are concerned with (1) imparting information and educating the public in achieving standards of compliance and preventing problems resulting from neglect or ignorance, rather than criminal intent; (2) reporting facts and data acquired from field inspections to assist in the intelligent direction of an over-all health program. The public health inspector is interested in the *whole* problem — his work is preventive as well as prohibitive. He attempts to inform citizens and operators of the legal authority he enforces and the ways and means of controlling health or nuisance problems, and motivates, rather than compels, compliance.

The air pollution inspector belongs to the family of the public health inspector since air pollution control is one of the many specialized public health programs. Inspection and enforcement techniques and practices have, in fact, derived from industrial hygiene and public health agencies. In Los Angeles County, this is reflected by the fact that the basic legal authority is contained in the California State Health and Safety Code.

In several other interesting respects, the air pollution inspector differs from other inspectors. In the first place, the air pollution inspector deals with abstract or indirect, as opposed to direct, justice. Ordinary crimes are confined to the persons directly involved, the thief and the victim. But in serious community-wide air pollution problems everyone is involved. Even though an emission from a single source may in itself be inconsequential, that emission contributes along with all other similar emissions to create an air pollution problem. Control and enforcement is thus not concerned with the individual, but with the statistical effects of individuals. The paradox here is that the relationship of the contributor to collective acts and to the production and intensification of smog effects is remote. The contributor is not often aware that he is violating the rights of others. The air pollution inspector has a more difficult job, since quite often, he cannot make an appeal to the violator directly on moral grounds, but may have to attempt to inform the violator of the consequences of his acts. This more abstract notion of enforcement requires that the inspector possess a working knowledge of the air pollution problem and the control programs.

Secondly, the air pollution inspector, working alone, first views the field as chaos, a condition in which he will have to find a path as gracefully and as tactfully as he can to the evidence or the facts he is trying to find. To the inspector, the field is something more than a zoned territory made up of many sources of air pollution. It is made up of people, the public, confrontations, amenities, human reactions, attitudes and opinions as well as a host of problems which are antecedent to actual air pollution control. The inspector is not able to obtain the facts he needs unless he is capable of managing the social relationships which arise.

Each source of air pollution, also, is inherently unique even though it may be conveniently classified on paper. The equipment, location of the equipment, management policies, the products and processes, the volume of production, plant layout, etc. differ from plant to plant. Some problems are highly complex in terms of equipment and processes. Others, involving a few simple pieces of equipment, may be complex in terms of the human factor alone.

The inspector, because he is for the most part alone in the field, works in an unstructured frame of reference. It is his purpose to apply a structure in the form of the law and the policies he enforces. His discipline then must be based on constant use of analysis and judgment in distinguishing between subjective conditions, e.g., states of mind, and objective facts; between procedures and policy making; between initiative and standardized practices; between literal interpretation of the law and the use of common sense; between inertia from continuous application of proven methods, and adaptation to changes in policies, laws and political situations.

In order to strike an effective balance between these extremes, the inspector must view the facts impersonally and by concrete rules, standards and criteria. He must possess the prerequisite abilities, the training, clearly established duties, ethics, policies, powers and the proper equipment with which to work. But, more important, he must be thoroughly grounded in inspection technique. Inspection technique is of fundamental importance to the inspection and enforcement program. It is an art insofar as the inspector must elicit information, deal with the public and organize and handle his inspections smoothly. Basically, the artful handling of material involves the creation and organization of material out of chaos, performed with efficiency and grace. It is also a science insofar as the inspector must accurately determine and evaluate all of the facts disclosed from each inspection in order that the most effective action can be taken.

Inspection technique can be continuously developed and promoted by the agency in training programs and by constructive supervision. If it is neglected, the control agency may find it necessary to establish cumbersome administrative machinery to compensate for the deficiencies in inspection technique. Within the limits of essential routines, the greater the efficiency of inspection, the less the complexity of administrative actions necessary to control the inspector in the field.

I THE INSPECTOR'S ROLE

The Air Pollution Inspector is involved with more phases of the control program than any other category of personnel. This degree of involvement is shown in Figure VII-1.

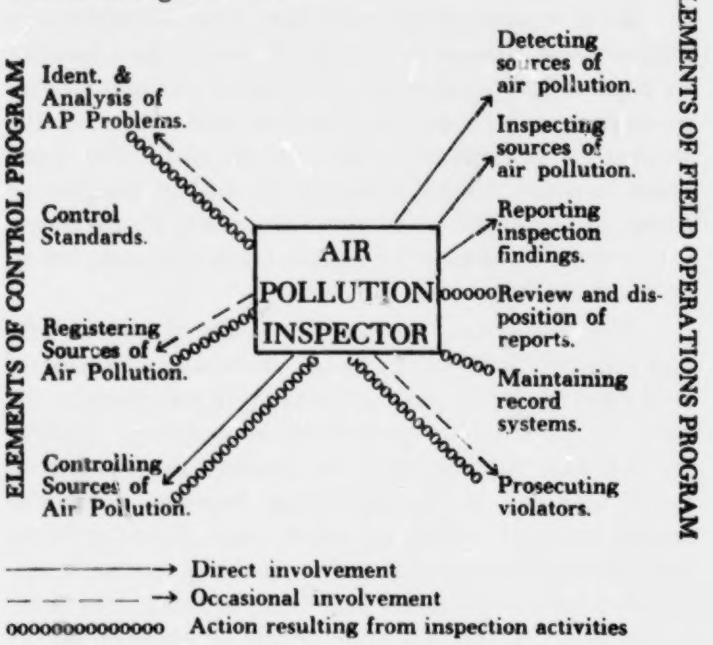

ELEMENTS OF CONTROL PROGRAM
Ident. & Analysis of AP Problems.
Control Standards.
Registering Sources of Air Pollution.
Controlling Sources of Air Pollution.
AIR POLLUTION INSPECTOR
Detecting sources of air pollution.
Inspecting sources of air pollution.
Reporting inspection findings.
Review and disposition of reports.
Maintaining record systems.
Prosecuting violators.
ELEMENTS OF FIELD OPERATIONS PROGRAM
→ Direct involvement
— — — — → Occasional involvement
oooooooooooooo Action resulting from inspection activities

Figure VII-1. Degree of involvement of air pollution inspectors in the control programs.

The control agency thus begins with the Air Pollution Inspector and builds accordingly. Those problems which cannot be handled by him alone are then assigned to specialists and technicians who are available to assist the inspector in handling problems requiring special research and analysis. The inspector, therefore, is not truly in isolation since the facilities and resources of the agency are behind him. As a matter of fact, part of his effectiveness in the field will depend on his ability to use these resources properly when he needs them.

The Air Pollution Inspector is a general air pollution technician, and should possess the ability to grasp the overall aspects of the program.

In the following, the various professional qualities or practices which enter into the qualification of the Air Pollution Inspector are examined.

A. Prerequisites

The educational background and previous experience required for candidacy for the base positions of Engineering Inspectors and Inspectors respectively in the Los Angeles County Air Pollution Control District are as follows:

> Engineering Inspectors: Candidates for the position of Engineering Inspector are required to possess a degree from an accredited college with specialization in engineering, chemistry, physics, or metallurgy. One year's experience in engineering, chemistry, physics, metallurgy or air pollution technical or enforcement work is permitted to be substituted for each year of college.
>
> Patrol Inspector: No academic requirements are stipulated. Candidates are required to achieve a relatively high score on a general intelligence test and are then screened through oral interview for such qualities as are needed for the position.

In addition to the formal requirements for employment eligibility, candidates are screened and selected for employment as follows:

1. Potentiality as Law Enforcement Officer

The inspector must be able to comprehend the law he enforces and relate the proper code sections or rules to the corresponding practical situations encountered in the field. Perhaps the most important single attribute that the inspector should possess is the ability to make logical and reasonable judgments. Judgment in this case means the ability to discriminate from the facts between flagrant, chronic, borderline or accidental violations, to recognize sincerity, intention, honesty, on the part of plant managers.

Emotional stability is also an important quality. The inspector must remain consistent and reliable without being readily influenced. The inspector must also be free of prejudices and biases which influence his judgment. He must be capable of analyzing situations for the objective facts and be able to enforce the law equally and firmly.

The ability of the inspector to express himself completely and accurately, orally and in writing, is also important since his findings are always being reported for proper action. Particularly is this important when an inspector testifies in court or explains a law or policy to a plant operator.

Approach and appearance are also important since the kind of appearance the inspector makes be-

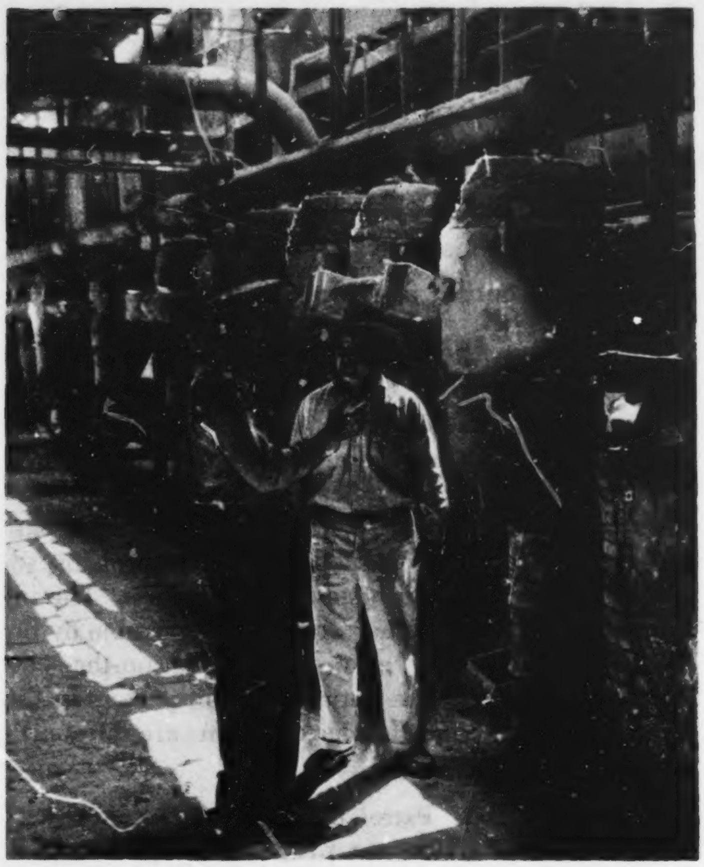


Figure VII - 2. An A.P.C.D. Patrol Inspector explains the air pollution control law to management as it applies to the zinc furnaces in the above plant.

fore the public influences compliance directly by his ability to obtain respect for and confidence in his function as a law enforcement officer for the Air Pollution Control District.

2. Background and Potentiality for Technical Expertness

The greater the technical background of the inspector, the more the field operations program will be able to probe field problems.

The technical background required of inspectors will vary according to the ultimate positions they will hold when assigned to one of the three Inspection Sections. There are, however, certain desirable technical qualifications which apply to all inspectors and which are either a part of the inspector's formal education or experience, or are provided the inspector during his initial and subsequent in-service training.

Since the specialized engineering functions of the Los Angeles County Air Pollution Control District are almost wholly contained within the Engineering Division, it is not necessary for all of the inspectors to be professional engineers. However, the minimum engineering abilities that must be possessed are: (1) a basic knowledge of combustion processes and equipment operation, (2) techniques for determining and reporting the causes of violation, and (3) the ability to identify and classify for source registration, equipment capable of air pollution.

Of these, determining the causes of violation in the preparation of reports is perhaps the most crucial. In determining the causes in all industrial violations, a considerable amount of practical air pollution experience is required. In complex cases, not only must air contaminants be identified and distinguished from water vapor or natural constituents of the atmosphere, but the inspector must possess a working knowledge of equipment, process, maintenance and operation.

Furthermore, in investigating a violation, the inspector must be prepared to analyze various phases of operating cycles of industrial equipment. He may have to correlate such data as excessive pouring temperatures, alloys, fluxes used, and relative volatilities of metals with the opacities or densities of emissions he observes. In each case, the inspector must be prepared to take any engineering analytical approach necessary to tie each violation to its cause.

Inspectors specializing in complex industries will generally require a greater technical background in chemistry or chemical engineering to enforce the law. In the refinery and petrochemical industry, for example, inspectors are required to understand all phases of the complex technology of the industry.

3. Ability to Deal with the Public

The inspector's ability to perform his assigned duties effectively, given a technical proficiency, will stand or fall on the manner in which he conducts himself with the public.

Since the inspector is in the field most of the time, he is constantly dealing with people—employers, employees, technicians, engineers, complainants, public officials, vehicle operators, etc. He must be able to approach each person according to the attitudes they manifest. Some individuals will favor the control agency's policies, others will be vehemently opposed; some will be cooperative, others may be belligerent and will seek to circumvent or obstruct the inspection.

Figure VII - 3. An A.P.C.D. training class for new field inspectors.

In this regard, the inspector must be polite and courteous, yet firm.

B. Training

Because of the recency of air pollution enforcement, the control agency must train its personnel. This training may continuously require extension and modification in order to accommodate the broadening scope of the control program. These include the following major elements:

1. Initial basic training, given to all inspectors.
2. Smoke reading training — given to all new field personnel entering the division and bimonthly thereafter. (See CHAPTER 10, IDENTIFICATION AND EVALUATION OF SOURCE PROBLEMS.)*
3. Specialized training to meet specific requirements.

The objectives of this program are to:

1. Develop proficiency in determining violations within prescribed standards.
2. Develop understanding of basic equipment operations and potentials for causing specific pollution problems.
3. Develop understanding of equipment inspection techniques capable of revealing those problems.
4. Determine the specific air pollution problems in any given area and the tracking of the problem to a specified source.

A course outline is shown in Table VII - 1.

C. Duties

The duties of the air pollution inspector immediately comprise the detection, inspection and reporting activities described in the previous chapter. These are, briefly, to patrol and conduct physical inspections and inventories of equipment, to interview responsible parties, witnesses and complainants, and to report inspection findings to supervisors and to the courts. The inspector also performs other duties made possible by his field deployment, such as air monitoring, on-the-spot-source testing, etc. The duties of the inspectors in the Patrol, Industrial and Refinery Sections are differentiated as follows:

1. Patrol Inspectors

The duties of the Patrol Inspector are as follows:

a. Patrol assigned sectors thoroughly and systematically in order to seek out all stationary and moving visible violations.

TABLE VII - 1

FIELD INSPECTORS' TRAINING PROGRAM

LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT

Subject	*Hours of Instruction*	*Frequency*	*Recipients*
INITIAL TRAINING.			
1. Program Orientation Introduction to L.A. Smog problem, objectives and organization of the District; personnel matters and note-taking.	7	On Entry	All inspectors
2. Legal Authority. The laws and rules enforced as well as peace officer's powers, rules of evidence, and Hearing Board and Court procedures and demeanor.	14	"	"
3. Report and Notice Writing. Recording facts and elements of corpus delicti on reports and notices.	8	"	"
4. Equipment Description and operation. Academic instruction on principal equipment and industries capable of air pollution.	4	"	"
5. Care and Use of Inspection Equipment. Care and use of emergency vehicles, stop watches, cameras, storage kits and communications.	5	"	"
6. Inspector's Duties and Responsibilities. Duties, conduct and ethics of inspectors.	4	"	"
7. Enforcement Division Policies. Conduct with headquarters, administrative policies of the divisions.	2	"	"
8. Activities of Inspection Sections. Operation of Patrol, Industrial and Refinery Inspection Sections.	4	"	"
Total	52		
INITIAL FIELD TRAINING			
1. Smoke School Actual instruction in smoke reading.	24	Entry	All inspectors
2. Field Orientation Bus tour of representative Industrial facilities.	8	"	"
3. Supervised Field Training Individual supervised instruction in the field.	80	"	"
Total	112		
SPECIALIZED TRAINING			
1. Industrial Engineering Insp. (no organized training program). Individual instruction given as needed for selected equipment inspections, source testing, etc.	Given individually as needed		Industrial Inspectors
2. Refinery and Petrochemical Covers all technical phases of refinery operations.	20-100	As needed	Refinery
3. Radiological Monitoring Theory and field practices of radiological monitoring	42	40 hrs. initial 2 hrs. once a yr.	All Inspectors
4. Driver's Training	8	Once	"
5. On-the-Spot Source Testing	Given individually as needed	As needed	Selected Refinery Inpectors
6. Air monitoring	20 lecture and lab - 20 field	Initial	
REFRESHER			
1. Smoke School	4	6 times per year	All Inspectors

Source: *Reference* 3.

Figure VII - 4. A.P.C.D. Patrol Inspectors and emergency vehicles.

b. Answer and investigate all complaints issued by radio, landline, memoranda, or instructions from supervisors.

c. Enter locations where visible violations are observed or complaints are involved in order to investigate excessive emissions.

The Patrol Inspector, however, does not enter a refinery or petrochemical plant, a plant operating under government control requiring a security clearance. Investigation of complaints and violations are made by making preliminary observations of the exteriors of these locations, and by calling upon the assistance of an Engineering Sector Inspector or a Senior Inspector, or by forwarding a report to the appropriate Section of the Enforcement Division.

d. Patrol Inspectors may also conduct some scheduled inventory inspections limited to non-industrial establishments such as hotels, hospitals, warehouses, auto sales and services, agricultural operations, etc., and government agencies including schools and colleges. These sources will involve either one or a combination of (1) incinerators (multiple-chamber or illegal single-chamber), (2) boilers, (3) paint spray booths, and (4) open burning in land clearing, agricultural or dumping operations.

e. Handle any other special assignments such as surveillance, continuous observation of smoke plumes for engineering tests and other related duties.

2. Industrial Engineering Inspectors

The Industrial Engineering Inspector:

a. Conducts inventory inspections and scheduled reinspections of all industrial plants where manufacturing or processing is involved, such as aircraft, automotive and trailer manufacturing, manufacture of construction materials, food processing, foundries, etc., and prepares equipment lists for each plant location.

b. Conducts physical inspection of equipment to determine operational and maintenance practices and general compliance with the Rules and Regulations and State Health and Safety Code or with variance conditions imposed by the Hearing Board.

c. Assures that equipment operates under valid operating permits, and takes action against all unpermitted equipment or infractions of permit conditions.

d. Checks for possibility of invisible emissions and requests source testing, if warranted.

e. Investigates reported breakdowns of air pollution equipment.

f. Investigates emergency air pollution problems developing in any industrial plant.

g. Conducts technical inspections which may be involved in selective enforcement activity, and assists patrol inspectors in acquiring evidence for observed visible violations.

h. Elicits the cooperation and confidence of plant management in order to encourage voluntary compliance. Advises management of proper operation of equipment, but does not offer engineering advice.

i. Handles complaints made against industrial establishments.

j. Handles special assignments and details. Makes opacity readings and observations for the Engineering Division on engineering final inspections and for the Research Division on laboratory tests. Engineering Inspectors are also required to participate in air sampling when an alert is predicted and during alert periods, and in air monitoring details during late and evening hours.

3. Refinery and Petrochemical Inspectors

The duties of the Industrial Engineering Inspectors assigned to the Refinery and Chemical Inspection Section are essentially the same as those described above for the Industrial Inspection Section, with the exception that effort is concentrated on refinery, petrochemical, chemical and allied plants. The degree of specialization, also, is generally higher than in the other sections. Inspectors selected for this section usually possess petrochemical and chemical backgrounds, and are specially trained. The Refinery Inspector also performs the following:

a. Conducts special and continuous inventories and surveys to locate, classify and quantify materials and equipment.

b. Develops test procedures and conducts on-the-spot tests for visible or lethal contaminants, rack tests to determine API gravity, Reid Vapor pressures, and quantities of H_2S, CO, etc., emitted to the atmosphere.

c. Refinery Inspectors systematically patrol sectors to provide refinery surveillance.

4. Night and Morning Watches

Night and morning watches are conducted for the purpose of maintaining continuous around-the-clock surveillance of the pollution zone. Enforcement personnel must thus be available for any emergency situation which might arise, to monitor the air and to answer complaints. A minimum crew is maintained, and the inspectors are deployed as required, rather than by sectors.

D. *Powers*

In Los Angeles County, the Air Pollution Inspector is a peace officer with powers restricted to those defined in the California Health and Safety Code. The essentials of this power are contained in Section 24246 which gives the Air Pollution Control Officer the power to:

1) Enforce any provision of the California Health and Safety Code, or any provision of the Vehicle Code relating to the emission of air contaminants or any order, regulation or rule established under the authority of the California Health and Safety Code.
2) Enter every building, premises, or other place, except a building designed for and used exclusively as a private residence.
3) Stop, detain, and inspect any vehicle, designed for and used on a public highway but which does not run on rails.

This power is delegated to the Inspector, who is a deputy of the Air Pollution Control Officer. This delegation is established by Section 24100 of the California State Government Code which states:

"Whenever the official name of any principal officer is used in any law conferring powers or imposing duties or liabilities, it includes his deputies."

Section 24223 of the State Health and Safety Code makes this delegation explicit:

"The Air Pollution Control Board may provide for assistants, deputies, clerks, attaches, and other persons to be employed by the Air Pollution Control Officer, . . ."

The Air Pollution Inspector, as a peace officer for the purpose of enforcing the air pollution control law only, possesses the power of arrest. This power is derived from the California State Penal Code. The inspector may make arrests for misdemeanors in air pollution law committed in his presence. However, such arrests are never made, except possibly in extreme cases of provocation, or assault by the violator. Even in such cases, arrests are made only with the assistance of a police officer. All infractions of air pollution laws, including those of Section 24246, can be handled by means of legal action, i.e., through the courts themselves.

E. *Policies*

A policy is a course of action usually agreed upon in advance; it is a rule or guide to conduct, a criterion for disposing of problems which continuously arise in the operations of an organization. In the case of the air pollution control agency, we may consider policy as anything which guides the conduct of field personnel, but which is not law itself.

Although the inspector is not directly one of the policy-making members of the Enforcement Division, he must be able to recognize situations in which policy decisions are called for. These are usually situations not covered by existing practices and procedures. All such questions are forwarded to the appropriate command level, to the Chief Inspector, Enforcement Director, or Air Pollution Control Officer and his staff. In such cases, it is of the greatest importance that the decision be made at that command level which is cognizant of all of the operations affected. Any given policy decision must be capable of being applied to all similar situations and must be consistent with other policies.

The inspector thus enforces and applies existing policy, and, also, raises questions which may cause the revision or institution of new policies. Because all situations will not be covered by strict rules or guides, the inspector must frequently be prepared to infer the proper course of action from general policy pronouncements. For example, the course to be taken in many diverse cases may be derived from the following statements:

1. The diversity of the enforcement program emphasizes one of the fundamental concepts of air pollution control: all sources of air pollution, regardless of size or economic importance, must be controlled or eliminated.
2. The Enforcement Division prescribes results, rather than methods of obtaining results. Inspectors do not engineer air pollution projects in the field or advise management on the construction of equipment. (Certain advice may be given as to operation, however.)
3. All violators who are either cited or served a written notice are prosecuted in the courts if

the evidence under investigation is sufficient.

4. Court cases are processed with dispatch and promptness in order that there be no delay in justice on the part of the District.

Policies evolve with respect to meeting the public, performance, personal conduct, and relations with Headquarters. All such policies should descend from clear and consistent principles of enforcement.

F. *Ethics*

Ethics deals with principles of honesty, of right action. An emphasis on ethical conduct and practices on the part of inspectors may often preclude restrictive internal policies designed to prevent unethical conduct.

For the air pollution inspector, existing engineering codes of ethics are adequate for all situations which may arise. However, there are several items which must be given more attention, particularly in a governmental agency, in order to avoid any possibility of misunderstanding on the part of the public:

1. Inspectors do not take any action or make any statement which interferes with any official act or decision of the District.
2. Information acquired in any plant should never be disclosed to a competitor.
3. The law must be applied uniformly to all. Uniformity of treatment is the basis of successful governmental control.
4. No special consideration can be given.
5. No firms can be recommended for air pollution control projects; no engineering recommendations will be made by inspectors.
6. Reports must not in any way be falsified.
7. No gratuities should be accepted.

G. *Inspector's Equipment*

In order to accomplish his duties, the inspector requires the use of the following equipment:

1. Vehicles

Two types of vehicles are employed in Los Angeles County — the emergency vehicle operated by Patrol Inspectors, and the neutrally colored county vehicles operated by Engineering Inspectors. Both are equipped with two-way radios. The purpose of the emergency vehicle is to enable inspectors of the District to remain on the road during any period of alert in which vehicular traffic is restricted, to speed to any local emergency of an air pollution nature, and to halt motor vehicles emitting excessive emissions. The Air Pollution Inspector cannot, however, use siren and lights unless he receives a Code 3 authorization from Headquarters. (Figure VII-4.)

Each Patrol Inspector is assigned a black and white emergency vehicle equipped with sirens, lights and two-way radios. In operating the vehicle, the Patrol Inspector must take extra care to obey the rules of the road at all times.

The operation of the emergency vehicle is exempt from the rules of the road under Section 22105 of the Vehicle Code under the following conditions:

a. In responding to an emergency call.
b. In the immediate pursuit of an actual violator of the law.
c. In the immediate pursuit of a suspected violator of the law.
d. In responding to, but not returning from, a fire alarm.

And when the following conditions are met:

a. A siren is being sounded in a manner which gives reasonable warning of the approach of the vehicle.
b. One lighted red lamp which is visible in normal atmospheric conditions for a distance of 500 feet is displayed on the front of the vehicle. (Secs. 21055, 22107, 22108).

Three things must always exist simultaneously before these exemptions provided by Section 454 of the Vehicle Code are effective:

a. The vehicle must be an authorized emergency vehicle.
b. One or more of the four circumstances listed above must exist.
c. Both a siren must be sounded and a red light displayed, simultaneously.

No privilege to operate a vehicle in disregard of the "rules of the road" can be established unless all of these facts can be proved. And having complied with all these conditions, the benefits of the privilege are still denied if the driver of the vehicle fails to show due regard to the safety of all persons using the highway, or arbitrarily exercises his privilege.

Even with the siren and light the peace officer must give adequate warning, and drive in a manner which shows regard, under the circumstances, for the safety of persons and property on the roadway. The siren must be sounded a sufficient time before reaching intersections to allow persons coming from intersecting roadways to adjust mentally, react physically, and bring their car to a stop before the emergency vehicle reaches the intersection. This warning can be more clearly given if the siren is sounded well enough in advance and in a manner which will cause a fluctuation in tone and volume. In congested areas, also, the emergency vehicle should be operated in second gear.

2. Test Equipment

A few emergency vehicles employed by the Refinery and Petrochemical Section are fully equipped with on-the-spot testing equipment used for testing local atmospheres. Such equipment includes test paper, M.S.A. gas testers, Tutweiler apparatus, M.S.A. midget impinger and gas absorption cell, Halide leak detector. Explosimeters or combustion meters, etc. In

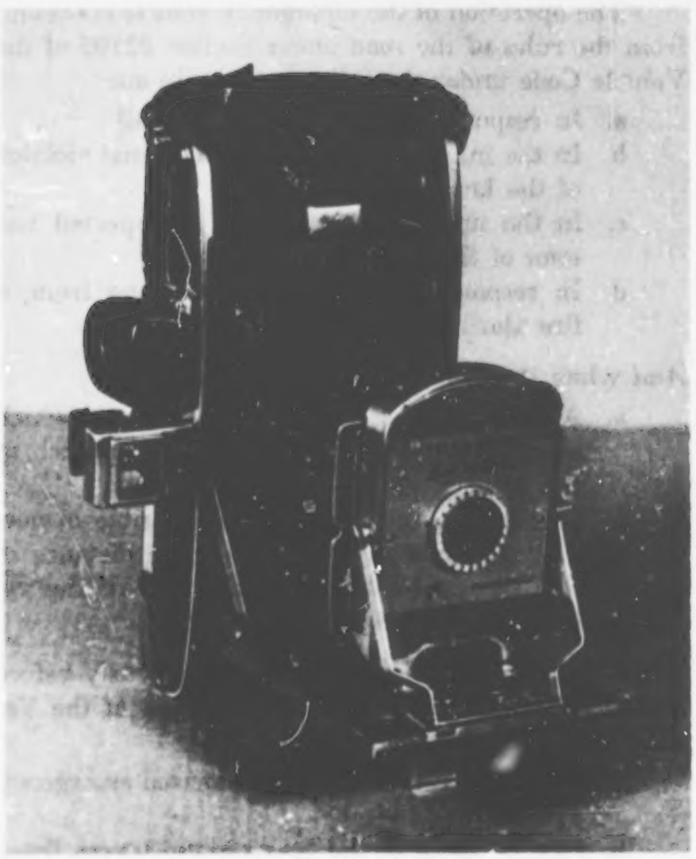


Figure VII-5. Polaroid Land Camera used for obtaining photographic evidence by inspectors in the field.

addition to such test equipment, all inspectors carry Geiger counters or ion chambers for radiological monitoring. (See Chapter 11.)

3. Cameras

Inspectors are issued Polaroid land cameras for assistance in gathering evidence in the field. These are capable of photographing and developing prints at the site of investigation. Cameras are used primarily to photograph excessive emissions from stacks and vehicles, equipment and operators for identification purposes. (Figure VII-5.)

4. Stop Watches

Inspectors are issued accumulative stop watches for use in recording total time period of excessive emissions.

5. Inspector's Kit

This kit is issued to each inspector for the holding and storing of all essential equipment including forms, cameras, flashlights, maps, etc., as a means of keeping all of such material organized in space allocated within the vehicle.

II CONDUCT OF THE INSPECTION

In air pollution field operations one single principle appears to apply more than any other: air pollution cases exhibit greater diversification than similarity. The classification of work and sources of air pollution break down so extensively that it is difficult to generalize on methods and principles, or to briefly illustrate typical instances. Yet, it would be well to consider in one place the steps taken in the conduct of an air pollution field inspection. An original inventory inspection is chosen here since it is usually the most thorough inspection conducted. The violation inspection, or other types of inspection differ according to the type of air pollution problems encountered. These will be discussed in greater detail in following chapters of this manual.

The inspection breaks down into five parts: (1) observation of the plant exterior, (2) interviewing plant management, (3) the physical inspection of equipment, (4) concluding the inspection, and (5) preparation of the report.

A. Observation of the Exterior

The outside of the plant is the first thing that the inspector observes. The general layout, relative size and location of stacks, vents, and incinerators are particularly noted. The inspector estimates the possible contaminants that could be emitted into the atmosphere by such a plant. He tours the periphery of the plant, unless it is so small that all sides can be observed without the tour, and takes notes to make certain that all observations of visible air contaminant emissions are recorded. Particular attention is paid to points of observation, location of emission, time, color, opacity of contaminant and accuracy of source description.

B. Interviewing Plant Management

The inspector enters the plant, identifies himself and attempts to contact the top authority before conducting any business with any other person within the plant. The inspector makes an effort to see the head of each plant personally; and in the event that this person is out, the next in authority and so on. This rule applies every time a plant is entered, unless the head of a plant designates a certain person to be contacted on future visits. This is a procedure which the

INSPECTOR'S MANUAL	EXTRA FILM STOP WATCH
PERMIT APPLICATION BLANKS	
MISCELLANEOUS	RULES & REGS.
DAILY REPORT PADS	NOTE BOOK
EQUIPMENT LIST PADS AND ENVELOPES	I.R. BLANKS
CAMERA	NOTICE PADS
	WORK CALENDAR

Figure VII-6. Inspector's kit.

dignity of the situation as well as common courtesy demands.

Before the plant is inspected, the inspector informs management of his planned inspection of the premises. Usually permission to enter is granted without question, but at times it is necessary to explain that the Health and Safety Code gives the inspector the right of entry. The inspector either reads or shows the plant head Section 24246 of the Code if necessary. If permission is then refused, the inspector does not enter forcibly but asks for a direct verbal refusal of entry and then informs the party concerned that such refusal is a misdemeanor. The inspector then reports at once by telephone to headquarters. Refusal of entry is rare, however, as most plants are prepared to cooperate.

The inspector then interviews the representative of plant management contacted. The interview accomplishes three objectives: (1) it informs the management of the purpose of the inspection, as well as imparts all information the plant manager may require regarding the air pollution control program; (2) it elicits information that the inspector requires to determine permit status and compliance; and (3) organizes the inspection.

The inspector approaches any individual in the plant at his own level of speech and understanding. It does harm to the inspector's prestige to use extremely colloquial English with an executive, but, on the other hand, it ruins cooperation if the inspector assumes a superior attitude and uses complicated words with a person whose vocabulary is limited. The inspector uses as clear expressions as will adequately describe whatever idea he is trying to implant. An interested and sincere, but not unfriendly attitude, creates the most desirable atmosphere for accomplishing the inspector's purpose.

After the plant manager is informed of the visit, the inspector then gathers preliminary data regarding the ownership of the plant, and the basic processes conducted by the plant. Pertinent laws regarding the permit system can be explained at this point in the inspection.

If the plant is exceptionally large or the processes employed are complex, the inspector plans the inspection with the manager or whoever is subsequently detailed to accompany him. The company escort thus assists the inspector in making a complete inspection.

In planning the inspection, the basic manufacturing processes are usually discussed. This provides an opportunity for the inspector to ask questions about unfamiliar processes beforehand. This is often quite helpful, since the working area of the plant may be too noisy for normal conversation. The inspector, after learning of the steps taken in the process, can formulate a department-by-department inspection plan. He generally follows the flow of materials, the actual steps through which the manufacturing process is conducted. As this is discussed the inspector collects operating data which he can verify when he inspects the equipment. A friendly discussion of this nature at the beginning of the inspection saves much time.

C. *The Physical Inspection*

The plant to be inspected will comprise one of two distinct types of situations — (1) a plant consisting of individual pieces of equipment units, such as a foundry, even though individual operations may be conveyorized, or (2) plants constructed on the basis of process units, i.e., equipment units inter-connected by sealed or ducted flow systems.

In a plant that is relatively simple, it is only necessary to list equipment units. In a more complicated plant a generalized box-type flow diagram on the reverse of the Equipment List may be required. Regardless of the type of plant, the inspector should always provide the information or diagrams necessary to describe the plant to one who has not seen it. (For process flow diagrams, see CHAPTER 14.)

The inspector then inspects each equipment unit individually and acquires information from his observations and inquiry. In collecting inventory data, it is essential to write down the data at the time it is given to avoid errors. Some inspectors find it necessary to draft information first on notes, others record the information properly in final form on the proper report form. The inspector then performs the following:

1. Identifies the equipment unit by function, commercial name and plant location.
2. Analyzes the physical operation of the equipment, from influent to effluent, determines degree of operation and use; notes capacity, general operational efficiency and compliance with conditions stated on operating permits.
3. Checks and evaluates all pertinent maintenance and operational practices.
4. Determines permit status, date of construction, alteration or structural modification since last visit for each piece of equipment.
5. Acquires evidence through observation and inquiry for any violation observed.

Much of the data can be observed directly at first hand, especially if the equipment unit is in full operation. Other data can only be elicited by asking developmental questions. If the latter approach is required, it is often best for the inspector to be genuinely interested in the process, to be curious about the operation, rather than to frame questions in terms of alleged guilt. In dealing with statements, the inspector may repeat them to assure their accuracy. This can always be done by stressing the fact that an accurate record of plant information protects management against the use of incorrect information.

The operational and maintenance practices are important as evidence, since negligence or ignorance may result in violations. The inspector is interested in the physical operation of the equipment in relation to the air contaminants emitted from the stacks or exhausts of the equipment. He checks those parts of the equipment, or phases of the operating cycle which directly affect the emission of air contaminants.

It should be noted that the inspector does not directly order or instruct the operator in proper operational and maintenance procedures. The inspector prescribes results rather than methods of obtaining results. He can discuss effective control practices as he knows them, but he is always careful to explain that the methods employed are up to management.

A quick analysis of the plant situation and the statements made by management enables the inspector to ascertain whether any violation observed is flagrant, chronic, borderline, or accidental in nature. The interview likewise enables the inspector to distinguish between sincerity, dishonesty, conscientiousness or negligence on the part of management.

These discriminations may be subjective, but if the inspector has used his judgment, he will be able to substantiate his findings and decisions, verbally or in writing. An analysis of a *corpus delicti*, discussed in Chapter 13, defines how these discriminations may comprise the facts in the commission of a crime. The guiding criterion in the field, as in the courts, is reasonableness, that is, is the plant operating within "due or just limits", and is the evidence compiled clear as to the intent and commission of a crime?

As the inspector checks the individual items of equipment and records them on his inventory list, he also determines the date each piece of equipment was installed so that he can evaluate the permit status of the equipment. In Los Angeles County the date of installation is important in determining whether or not equipment requires permits. Equipment capable of air pollution requires a permit to operate if installed after February 1, 1948. (See (1) "When Permits Are Required," Chapter 14.) The inspector explains the air pollution control law in each case.

In completing all items required on the Equipment List, the inspector attempts to determine whether or not any alteration of the equipment has taken place since the last inventory inspection. He checks for the posting of permits near the equipment, as required by Rule 10 and determines whether or not the equipment is being operated according to the conditions stated on permits (Section 24280).

D. *Concluding the Inspection*

In concluding the inspection, the inspector compliments the plant operator on a well operated and clean plant. However, the operator is not told that he "does not violate" the air pollution control laws when what is meant is that he is not violating at the particular moment under consideration.

At this point, the inspector may desire to review the results of the inspection with the plant operator. If the plant manager needs operating permits for some of his equipment, the inspector explains the procedure for submitting the applications and the dates the applications are due. The inspector supplies application forms together with any written requests when permits are mandatory. He also supplies the plant operator with additional forms when he learns through inquiry that plant expansion is contemplated. If the operator has also shown interest in the air pollution problem, the inspector may leave appropriate informational publications.

The inspector then takes his leave without unnecessary delay. The plant operator has taken time from his usual duties to be with the inspector, and his time represents money. The leave is taken on a friendly note.

E. *Writing the Report*

After the inspector completes the inspection, he writes his report. Since reports are usually short and can be confined to the report forms, they are written just as soon as the inspector reaches his vehicle. Occasionally, when inspections are highly technical or are involved, and data at headquarters are required, the inspector may complete his report at headquarters. This is especially true when the inspector needs to check plans and specifications in permit application folders.

Since inspector's reports are short, the inspector must be able to select essential and relevant details and to describe them accurately and coherently. This is important since the inspector, by taking an interest in the plant, may have gathered a great deal of information. Only a portion of this information relates to the air pollution problems which may be encountered. The inspector attempts, however, to be complete and accurate. He cannot be so if he has not fulfilled the objectives of his inspection. An effective report, therefore, correlates directly with the quality of the inspection.

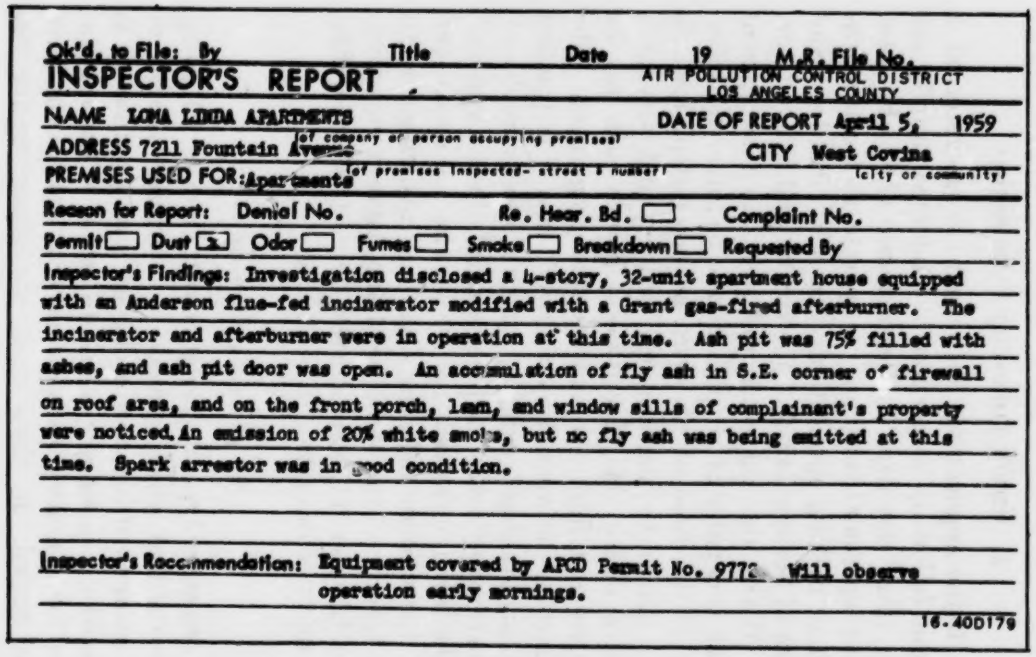
The inspector completes from his notes and his recorded data the following sections of the report: (See Figure VII-7 and also Figure XIV-10, *Activity Status Report.*)

1. The Heading

The heading consists of the accurate identification and location of the source of air pollution: the name of the company and the address, the date, time and interval of time of the inspection, the name and title of the person contacted.

2. The Findings

The findings first show the *reason* the plant was inspected. Then only the facts of the observation are reported, such as the densities or opacities of emissions observed, time intervals and time of emissions, a definitive description of equipment involved, operating



Ok'd. to File: By Title Date 19 M.R. File No.

INSPECTOR'S REPORT

AIR POLLUTION CONTROL DISTRICT
LOS ANGELES COUNTY

NAME LOMA LINDA APARTMENTS (of company or person occupying premises) DATE OF REPORT April 5, 1959

ADDRESS 7211 Fountain Avenue (of premises inspected- street & number) CITY West Covina (city or community)

PREMISES USED FOR: Apartments

Reason for Report: Denial No. Re. Hear. Bd. ☐ Complaint No.

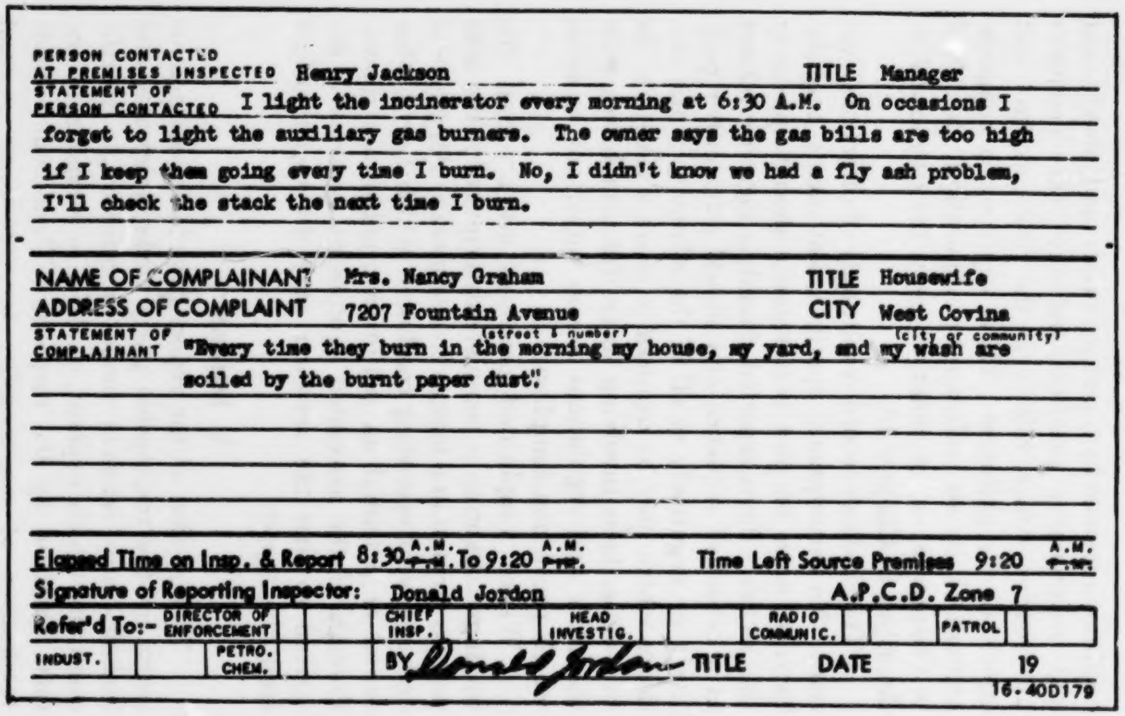
Permit ☐ Dust ☒ Odor ☐ Fumes ☐ Smoke ☐ Breakdown ☐ Requested By

Inspector's Findings: Investigation disclosed a 4-story, 32-unit apartment house equipped with an Anderson flue-fed incinerator modified with a Grant gas-fired afterburner. The incinerator and afterburner were in operation at this time. Ash pit was 75% filled with ashes, and ash pit door was open. An accumulation of fly ash in S.E. corner of firewall on roof area, and on the front porch, lawn, and window sills of complainant's property were noticed. An emission of 20% white smoke, but no fly ash was being emitted at this time. Spark arrestor was in good condition.

Inspector's Recommendation: Equipment covered by APCD Permit No. 9772. Will observe operation early mornings.

16-40D179

(*Front*)



PERSON CONTACTED AT PREMISES INSPECTED Henry Jackson TITLE Manager

STATEMENT OF PERSON CONTACTED I light the incinerator every morning at 6:30 A.M. On occasions I forget to light the auxiliary gas burners. The owner says the gas bills are too high if I keep them going every time I burn. No, I didn't know we had a fly ash problem, I'll check the stack the next time I burn.

NAME OF COMPLAINANT Mrs. Nancy Graham TITLE Housewife

ADDRESS OF COMPLAINT 7207 Fountain Avenue (street & number) CITY West Covina (city or community)

STATEMENT OF COMPLAINANT "Every time they burn in the morning my house, my yard, and my wash are soiled by the burnt paper dust."

Elapsed Time on Insp. & Report 8:30 A.M. ~~P.M.~~ To 9:20 A.M. ~~P.M.~~ Time Left Source Premises 9:20 A.M. ~~P.M.~~

Signature of Reporting Inspector: Donald Jordon A.P.C.D. Zone 7

Refer'd To:-	DIRECTOR OF ENFORCEMENT			CHIEF INSP.			HEAD INVESTIG.			RADIO COMMUNIC.			PATROL				
INDUST.			PETRO. CHEM.			BY Donald Jordon				TITLE		DATE		19			

16-40D179

(*Back*)

Figure VII-7. Front and back sides of an *Inspector's Report* of a typical incinerator complaint. In the APCD, the *Inspector's Report* is used for all situations in which the inspection findings are negative and are not covered by any of the other report forms. For example, the report is used to cover situations which are borderline, doubtful, suspected (in the case of visible contaminants), or are otherwise uncitable. This form is also used to report follow-up inspections (permit, denial, memoranda, compliance checks, complaints and variances), plant surveillance and complaints. An inventory inspection, on the other hand, such as is described in this chapter, is reported on special inventory forms (see Chapter 14), while a violation is reported on a Written Notice or Citation of violation (see Chapter 13).

conditions such as fuels and materials used, operational and maintenance practices and any other pertinent information which relates to the cause, control and effects of air pollution. These represent a complete account of the air pollution "configuration" described in Chapter 9, or, in violation cases, the *corpus delicti* described in Chapter 13.

The findings record results only of direct observations. No assumptions, opinions, statements, speculations or notes on past performance should appear in this section. Facts reported should be logically related in a causative sequence and should refer either positively or negatively to all of the elements of the evidence which may be *required* to prove a violation. In this sense, facts involving successful compliance with the rules and regulations are as important as those which prove non-compliance.

Where complicated processes are involved, the findings constitute a complete description of the unit process written in a logical flow sequence. All physical and chemical operating conditions which bear on the actual or potential air pollution problem are shown. Enough of the associated equipment involved is described so that the reviewer may draw conclusions from the report.

3. Statements

This section of the report records the statements made by the responsible party under interview and includes any remarks made or answers to specific questions which explain, qualify, or supplement the facts observed by the inspector. These will include verification of responsibility for equipment, general maintenance and operational policies, admissions as to compliance and non-compliance and knowledge of air pollution laws.

The statements that the inspector records are germane to the intent or negligence involved in compliance and non-compliance with air pollution laws.

This section also provides space for any statements made by complainants under interview.

4. Conclusions

This space is used to summarize the findings and the statements made and to make recommendations regarding the filing of the report, scheduling of a reinspection, or recommending some specific type of headquarters action. It is also used to record pertinent comments or warnings the inspector made to the responsible party. The inspector's assumptions, opinions, statements, recommendations, speculations, or notes on past performance may also appear here.

The report concludes with the signature of the inspector and the sector number.

F. *The Reinspection*

The frequency and type of reinspection depend entirely on the factors involved in each plant situation. A chronic problem of air pollution in any given plant may require numerous reinspections. Some plants may require inspections or observations of the exterior once each day, others are inspected only for the purpose of the inventory inspection once or twice each year.

The criterion for conducting reinspections should be made on logical grounds. A logical schedule of reinspection is deduced directly from the data gathered on preliminary inspections and is based on such factors as the time equipment operates, shuts down, starts up, the dates unusual materials are processed, the season of greatest productivity, curtailment of natural gas, and complaints.

1. Inventory Reinspection

It is the purpose of the inventory reinspection to determine what changes and improvements have been made since the inspector's last visit. If equipment which requires an air pollution control permit has been installed in the interim without proper authorization, the inspector issues either a written Notice or a Request for Application for A.P.C.D. Permit depending upon whether he finds that the construction of the equipment constitutes a flagrant or willful violation, or whether extenuating circumstances are involved.

2. Permit Follow-up Reinspection

If the applications for permit are not received, a permit follow-up inspection is conducted usually ten days (the "due date") after issuance of the Request. If the operator continues to operate this equipment without making application, he can be cited for a violation of Section 24279 of the Health and Safety Code.

When the inspector discovers the equipment which is capable of air pollution to be under construction at the time of his visit, he takes steps towards legal action by immediately writing and serving a written notice. He also issues a Notice each day he returns and finds the construction progressing. The distinction between unauthorized new construction and unauthorized existing construction is made administratively since in those cases in which a violation of the law is involved, the District has an option and can discriminate between situations involving neglect and ignorance and those involving flagrant violations. (See Chapter 11, COLLECTING AND REPORTING EVIDENCE OF VIOLATION.)

3. Denial Follow-up

Another type of permit reinspection or follow-up concerns that which is made to determine whether or not equipment has been removed from premises or is otherwise secured against future use, after the applications for operating permits for such equipment have been denied. In these cases, no administrative distinctions are made unless the applicant has taken steps within a ten-day period to petition for a variance or review of denial to the Air Pollution Control Hearing Board. If this has not been done, then continued operation of equipment is a flagrant violation of the law. When the inspector returns and finds such unpermitted equipment in operation, he issues a Notice of Violation.

Reinspections conducted to investigate public nuisances may be more complex and are described in greater detail in Chapter 12.

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CHAPTER EIGHT

HANDLING THE CITIZEN COMPLAINT

I THE ROLE OF PUBLIC RELATIONS IN THE CONTROL PROGRAM

Since air pollution is exposed to public view, the citizen complaint is likely to become an important part of field operations. Complaints made to the control agency fall into two general categories: (1) protest against general air pollution conditions, and (2) complaints against specific sources of air pollution. The more severe and frequent the air pollution problem, the greater the number of complaints. It is therefore necessary to consider the role public relations plays in the control agency, since the information available to the public has an important influence on the way field inspectors handle complaints, and on the usefulness and pertinency of citizen complaints to the field control operations program.

The propriety of conducting a public relations program by a government agency frequently is raised. Actually, it is difficult to generalize on ethical practices in this matter, except to state that public relations in government is limited to the advancement and exposition of public policy and to the dissemination of facts and information necessary to the proper functioning of a democracy, and should not be used for political purposes.

Still, within such limits, the question is raised whether public relations should be active, aggressive and professional, or whether it should be passive and limited only to answering individual complaints. Should public relations attempt to anticipate complaints? Should it attempt to elicit support for necessary legislation?

The answers to these questions determine the nature of the services to be provided. The functions and problems of police, health or fire departments are clearly visualized by the public. Therefore, an agency like a police department may seek by means of a public relations program to maintain a good feeling and understanding between the department and the community. Such departments may also engage in programs intended to prevent crime, disease and fire disaster by means of public information and education, as well as various types of community relations programs. Such practices generally go unquestioned.

A new agency created to control a problem like air pollution has entirely different needs in public relations. In this case, an air pollution control program must be advanced to the public for acceptance. Before acceptance is possible, the facts must be presented, as well as those difficult areas of the problem requiring research. The public, then, must be constantly informed of the facts, developments, successes, failures and problems faced by the agency. If the public lacks such information, the control program will not rally the support essential to its success.

Because smog tends to induce widespread annoyance whenever it occurs, a public information and education program is especially required in air pollution control. Regardless of the steps taken towards control, public complaints will continue as long as there is smog. If the causes of smog are not obvious, then it becomes easy for individuals to invent or to imagine causes, and to direct blame unfairly on the basis of personal bias. For example, when an air pollution problem appears in a community, "big business" is likely to be blamed, and quite often a specific industry will be named. Here it is important to realize that while many "big" businesses contribute to a complex problem, others may not, and that *many* small sources may contribute far greater amounts of pollution than one large source. In such situations, the size of a business or its commercial prestige may have little to do with the amount of pollution it produces.

The control agency and local government in general may also be condemned. The less informed the attacks are, the wilder the generalizations made by the public. Uninformed protest usually arises as a result of a lack of understanding of the *causes* and *effects* of smog, and the progress and problems of the control program. As generalizations based on misinformation can lead to distortion, confusion, hysteria and, ultimately, civic paralysis it is of the utmost importance that the public be exposed generously to the facts about air pollution control.

II HANDLING THE GENERAL SMOG COMPLAINT

The general type of smog complaint consists of expressions of annoyance, discomfort, or displeasure with prevailing smog conditions. It is generally expressed in terms of eye or respiratory irritation, reduction in visibility, or general dissatisfaction with control progress.

Quite often complainants imply that 1) a single or a group of industries is responsible for the air pollution in the community, and 2) government is incapable or unwilling to solve the problem.

Since the control agency is already engaged in abatement activities there is no special action that can be taken on the general smog complaint, except to impart to the complainant as much information as possible. This is done through normal public relations activities conducted by a Public Information and Education staff. It is the duty of this staff to answer all such complaints and to release information concerning the activities of the control program to all communication media. Most of the other personnel in the agency are

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also called upon to answer telephone complaints made by the public. Enforcement personnel, in particular, perform a public relations function since they are in constant contact with the public in the field.

The answer given to each complainant, of course, depends on the nature of the complaint. The employee who responds to the complaint is not being challenged to debate. He serves a valuable function in letting the complainant "get it off his chest." On the other hand, he imparts information regarding both the progress made and the problems or obstacles to control being encountered. This can be done by telephone or by sending the complainant literature on the subject.

In answering the general type of complaint, it is often necessary to point out the multiplicity of sources, mass emissions, the collective nature of the responsibility, and the legal, social and economic framework within which the control agency must function. It also may be pointed out that air pollution problems involve significant unknowns which require research, especially where proven control methods in certain crucial areas of the problem are not available. The answers to all such smog complaints are generally reducible to the "control-of-the source" concept described in Chapters 2 and 3 of this manual.

It is extremely important in all of these cases for the employee not to become so involved in the complaint that he becomes emotional. On the other hand, neither should he apologize, or assume a purely defensive position.

The facts cited in answering complaints should be honest, accurate and complete, and should be recited in a calm and friendly manner. If the agency has an unsolved problem, that problem, or any recognized deficiency should be admitted and the steps being taken to correct it explained.

It is important that the employee never regard such complaints as being directed against him personally. Rudeness and insults should not arouse anger or place the employee on the defensive. There are, of course, situations of unwarranted abuse *after* the inspector has accommodated the complainant to the best of his ability. If the complainant does not accept the honesty or accuracy of the facts, after it has been explained that such data is a matter of public record, such abuse need not be any longer accepted by the employee, and the conversation should be turned over to a higher employee, if circumstances permit, or it should be terminated.

In the area of general public relations, the field inspector accomplishes more by creating an effective agency image through his deportment, than by mere persuasion. The inspector's appearance, manner, speech and general competence creates confidence in the activities of the agency. In responding to complaints, the inspector makes that response which is appropriate to the dignity of a governmental agency. The inspector *never* expresses anger. An inspector is courteous, helpful and firm if necessary. If relationships break down, they should be terminated.

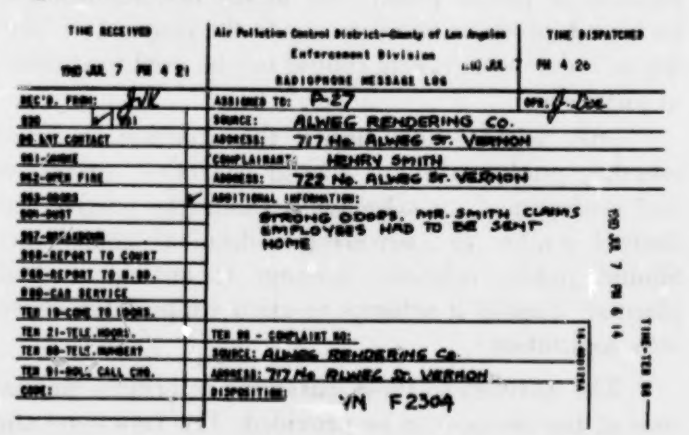
III HANDLING SPECIFIC SOURCE COMPLAINTS

A. *Receiving the Complaint*

In the Los Angeles County Air Pollution Control District, the switchboard operator determines whether the complaint is concerned with a specific source, or with general smog conditions. If it is the former, the call is forwarded to a Senior Engineering Inspector in the Enforcement Division.

B. *Dispatching an Inspector*

The Senior Inspector then immediately notes the names and addresses of the source and the complainant respectively on a Radiophone Message Log (Figure VIII - 1). He attempts to determine the validity of the complaint, the nature of the problem, and exactly what a field inspector could accomplish. In some instances it is unnecessary to dispatch an inspector since the location may already be under investigation. In other cases the source may already have been reported by the inspector in the field.



TIME RECEIVED
JUL 7 PM 4 21

Air Pollution Control District—County of Los Angeles
Enforcement Division
RADIOPHONE MESSAGE LOG

TIME DISPATCHED
JUL 7 PM 4 26

REC'D. FROM:
ASSIGNED TO: P-27
OPR.
SOURCE: ALWEG RENDERING CO.
ADDRESS: 717 No. ALWEG ST. VERNON
COMPLAINANT: HENRY SMITH
ADDRESS: 722 No. ALWEG St. VERNON
ADDITIONAL INFORMATION:
STRONG ODORS. MR. SMITH CLAIMS EMPLOYEES HAD TO BE SENT HOME

998-REPORT TO COURT
990-CAR SERVICE
TEN 19-COME TO HDQRS.
TEN 21-TELE. HDQRS.
TEN 80-TELE. NUMBER?
TEN 91-ROLL CALL CHG.
CODE:

TEN 90 - COMPLAINT NO:
SOURCE: ALWEG RENDERING Co.
ADDRESS: 717 No. ALWEG St. VERNON
DISPOSITION: VN F2304

JUL 7 PM 6 14

Figure VIII - 1. Radiophone-Message Log used for recording pertinent information upon receipt of landline complaint, dispatching of inspector, and reporting final disposition.

In most instances, however, the benefit of the doubt is given to the complainant. If the Senior Inspector is able to acquire enough facts to dispatch the sector inspector either to a specific source location or to the complainant, investigation is warranted.

After the Radiophone Message Log is completed, a complaint number is assigned, the time is stamped on the log and an inspector is dispatched immediately to the scene. Complaints are investigated as speedily as possible to insure that the reported source may be reached while the violation or nuisance is still in progress.

C. *Approaching the Complainant*

Upon arrival in the vicinity, the inspector first observes the source to determine if a violation is involved. If a violation is observed, the inspector investi-

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gates, writes and serves a notice, if warranted. Then he visits the complainant. However, if no violation is immediately apparent, the inspector contacts the complainant first. This is most often the procedure followed.

The inspector makes every effort possible to avoid obvious identification of the complainant. He is particularly careful not to park his official vehicle too close to the complainant's residence should the complainant and the source be near each other. *The inspector considers the identities of all complainants to be confidential and never, under any circumstances, discloses them to anyone who is not an employee of the District.*

The inspector then attempts to contact the complainant. If he is not at home, he leaves his calling card, and tries to contact him again at some other time. If he is at home, the inspector identifies himself by name and agency in a friendly manner.

D. Listening to the Complainant

The ability to listen carefully is one of the skills the inspector develops to gather facts.

The inspector is friendly, but dispassionate. He generally employs a "non-directive" interview technique in that he allows the complainant to get the matter off his chest so that the facts of the situation can be calmly discussed. The inspector also appreciates the fact that a person who is angry may honestly be motivated by a serious or chronic air pollution condition. The complainant may, in fact, be living in a daily nightmare if he is particularly sensitive to or fearful of exposure to air contaminants. A local pollution problem may be as aggravating to persons affected as the smog problem is to the general community.

In permitting the complainant to speak his mind, it is well for the inspector not to interrupt. It is particularly effective, however, that when facts appear, that the inspector repeat them aloud for verification, and then jot them down.

E. Conducting the Inquiry

After the complainant has expressed himself, the inspector then proceeds on a line of questioning which will 1) determine the *cause* of the complaint, and 2) the nature and source of the air pollution problem cited in the complaint. The line of questioning in this case is intended to complete and verify the data supplied by the complainant.

The *cause* of the complaint, it should be noted, may not always involve air pollution. Although most complaints are justified, some will concern problems over which the control agency has little or no control and in which air pollution may play a minor role. These concern backyard feuds, natural contaminants, resentment towards a nearby company, or small concentrations of contaminants which may affect illness or allergy in an individual. Although the inspector may have no legal powers in such cases, he thoroughly investigates and attempts to correct all air pollution problems. If such complaints are unsubstantiated, the inspector establishes the *cause* of the complaint, and documents the fact that no violation has occurred by recording the operational data of the equipment at the alleged source.

In verifying the validity of the complaint, the inspector attempts to recognize contradictory, exaggerated and biased statements. He may politely challenge terms used by the complainant to denote fequency or inclusiveness such as "generally", "sometimes", "never", "all of the time", "rarely", in order to distinguish first-hand knowledge or experience from speculation and inference. Precise indications of frequency may be crucial in tracking a nuisance to a specific piece of equipment.

In order to obtain the necessary data, the inspector inquires to obtain the following:

1. Name and location of source complained of.
2. Frequency of annoyance or occurence of plume.
3. Time of day nuisance was first noticed.
4. Duration of nuisance at each occurrence.
5. Names and addresses of persons affected.
6. Location and extent of property damage, if any.
7. Description and frequency of any illness alleged to have resulted from the air contaminants.
8. Description of odors, if any involved.
9. Any other information the complainant may have that will relate the nuisance to a specific piece of equipment.

In an air pollution problem which appears to have an immediate effect on health, the inspector records all observed or reported symptoms such as:

nausea
vomiting
headache
eye-irritation
fever
constriction of chest
eye tearing
soreness of throat
nasal discharge
turning blue
cough
difficulty of breathing, etc.

If the symptoms are serious, a doctor and the health authorities should be contacted. The control agency should also be immediately notified in order that an emergency vehicle may be dispatched to the scene to measure the concentrations of any possible toxic contaminant. (See Chapter 11.)

It should be noted that only a doctor can make a diagnosis. The inspector records reported symptoms under the complainant's remarks on the *Inspector's Report*. The inspector can note under "findings" the name of the doctor conducting the diagnosis and treatment. This information is important if public nuisance action should be initiated.

In his questioning, the inspector attempts to anticipate the laws that may be violated. Although the inspector cannot come to any definite conclusion at this point, since he must inspect the source of air pollution first, he is always visualizing the problem in his mind so that he can consider all possible facets and solutions. This may be temporarily necessary in order that the complainant may be given some realistic estimate of the situation.

While interviewing complainants, the inspector does not promise legal action nor does he commit himself or the control agency to any course of action. He should, however, explain to the complainant the laws involved and the evidence required to instigate legal proceedings. But he will also explain that he will first attempt to seek such cooperation on the part of those responsible.

F. *Physical Inspection of Complainant's Property*

Next, during the course of the interview, the inspector examines the complainant's property for any deposits or effects of air contaminants such as paint or acid stains, dusts, odors, fly ash, etc. The pattern of fall-out of contaminants may indicate the direction from which they came. If a malodor is detected at the complainant's property, the wind direction can be determined for the purposes of tracing the odor to its source.

G. *Canvassing*

As a rule, air pollution inspectors do not solicit opinion in a neighborhood regarding the behavior of any plant, but confine themselves to those persons volunteering complaints. It is usually citizens who do the canvassing and who forward the information to the air pollution inspector. The inspector may then interview all complainants involved. The canvassing of complainants by the inspector is usually discouraged because the inspector is not sampling, and does not act on, opinion, but on properly motivated complaints. The canvassing by the inspector of the neighborhood can be construed in a court of law as being prejudicial to the plant.

In some complaint situations, however, where the inspector cannot assess the validity of the complaints from his own direct observation and judgment he may wish to canvass the community. In such cases the inspector is interested in determining the degree to which an air pollution problem exists. That is, if there is a problem which is:

existent, but not objectionable
tolerable
offensive
utterly intolerable

In canvassing, the inspector, on the basis of his knowledge of air pollution, evaluates the consistency, correspondence, and intensity of remarks made by all of the witnesses. He attempts to find some degree of unanimity regarding the objectionability of the problem among those who might be equally affected. Diverse opinions and inconsistencies are first signs that a public nuisance may not be easily developed.

As with the initial complainant, the inspector's prime purpose is to obtain facts. He never urges, forces, or persuades persons to agree to become witnesses. Nor does he ask questions in such a way as to indicate that support for a legal action is being solicited. The inspector wants to know, first, the degree to which the witness is affected. He attempts to determine if the person is so affected by the air contaminants that he desires to appear in court as a witness. Some witnesses may be adversely affected, but are not willing to testify in court. The unwillingness does not mean that the problem does not require correction, however.

H. *Inspection of the Source*

From the facts gathered so far, the inspector may already have a notion of what it is he should inspect, especially if he has identified contaminants and has observed definite evidence of damage, or detected odors on the complainant's property. In other cases, he may know the identity of the contaminants, but not the source of origin, and will have to first locate a possible source to inspect. And in still other cases, the contaminant may be completely unknown. The tracking and identification of contaminants are discussed in Chapter 12.

The inspector's immediate problem in a public nuisance case is to find enough evidence to prove that a source of emission in a certain plant is responsible for the nuisance. In some cases, the equipment involved may be obvious; in others, especially in a plant containing many pieces of equipment, the source may be difficult to locate. In the latter instance, the inspector may be required to inspect each piece of equipment in detail, and to eliminate from consideration those which do not contribute to the air pollution problem.

Quite often the job is completed if the complaint or nuisance also involves a violation of the Rules and Regulations through the emission of contaminants in excess of that allowed, or through the operation of unpermitted equipment, or through operation of equipment contrary to permit conditions. In these instances, the action to be taken is indicated.

If, however, the nuisance is a result of quantities of air pollution which are *allowed* by quantitative standards in the Rules and Regulations, a public nuisance will have to be proven.

When the inspector contacts the plant operator, he explains that he is investigating a complaint, unless, in the individual instance it should be strategic not to do so. The inspector may also explain that he is trying to determine whether or not the complaint is justified. This gives management the opportunity to state its case, since it knows that the inspector is not yet committed to any action. As with the complainant, the inspector is also attentive and takes notes. Then, on the basis of the information he acquires from the complainants, he asks developmental questions, and completes the story. He then inspects the equipment and compares actual operating conditions, cycles and times of operation, with the times and frequencies of complaints.

I. Mediation

Because the inspector is an indifferent observer between two parties in conflict, he has a natural tendency to act as mediator and will attempt to find that solution to a problem which will satisfy both the complainant and the operator. For example, if the complaint is made of an operation conducted in the evening when the complainant is at home, the operator may agree to shift the operation to a daytime schedule. The company may also agree to relocate equipment, put a spark arrestor on an incinerator stack, raise a stack, and even eliminate a process unessential to the business activity as a means of becoming a "good neighbor". It is important, however, that such agreements do not compromise the law. The inspector does not agree to a maintenance of a violation. But, on the other hand, when there is no legal solution to a problem, the plant operator can do whatever he wishes to improve the situation.

The inspector attempts to promote such solutions. He can make a direct appeal to management by relating previous histories of similar nuisances, recalling the three inducements for control: 1) conservation, 2) public relations, and 3) employee relations. When complaints are made as a result of a grievance it is always wise to attempt to develop the "good faith", upon which continued neighborhood harmony depends, of all parties concerned. A plant operator improves his standing in the community if he solves his problem voluntarily. The inspector is always willing to explain this fact. As a matter of fact, plants with progressive public relations programs will often monitor their own operations by canvassing the neighborhood, and by adopting an effective air pollution control policy.

If the company is demonstrating good faith through purchase of new equipment, or modification of old equipment under permit approval to correct its problem by clearly established deadlines, then the inspector informs the complainants involved of the probable deadline or correction date and the progress being made by the company.

J. Public Nuisance

The most difficult type of air pollution case is the public nuisance. A public nuisance frequently occurs when a number of persons are annoyed by a quantity of contaminants which is otherwise allowed. The problem in cases of alleged public nuisance is to determine whether a private dispute or a valid public dispute is involved. If a private dispute is involved, then the citizen must initiate his own legal action. A public nuisance, however, involving a "considerable number of persons" or a reasonable cross-section of the immediate community affected is handled as an enforcement action by the District. (See Chapter 12.)

Once the inspector determines that a public nuisance is involved, he must assume an attitude of objective indifference since the rights of the company to maintain the alleged nuisance, and the rights of the citizens to be rid of it, constitute a conflict of equities which can only be resolved in court. The burden of proving the public nuisance ultimately rests on the testimony of the complainants themselves. The inspector is also a witness in that he can, in his opinion, verify the existence of the nuisance. But if, after thorough review, the control agency does not feel a valid nuisance is involved, it will not initiate legal action.

The inspector explains the facts to all parties concerned. In some cases, he may motivate the company to remedy the problem since many firms attempt to maintain good public relations in the community. The inspector will also explain all of the facts, rights and laws involved, as he has determined them, to the citizens and what actions can and cannot be taken.

He then distributes special District Attorney forms to be completed and signed by the complainants in their own handwriting. These documents, together with the inspector's findings of the problem, are filed as a Section 24243 violation in the courts to test whether or not a public nuisance exists. (See Chapter 13.)

It is necessary, also, that in interviewing complainants that the inspector be candid and discreet. There may be situations in which the District cannot act to solve a public nuisance due to a lack of the "considerable number of persons" required, contradictory testimonies or the unwillingness of complainants to testify in court. The inspector should clearly explain to the complainants once he determines that a public nuisance is involved that the only substantial evidence is the testimony those who are affected by the contaminant are prepared to give.

At the same time, the inspector must not aggravate the situation by leaving an angry community in his wake. The names of complainants must be held in the strictest confidence, and the inspector should avoid making derogatory statements about any of the parties concerned.

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CHAPTER NINE

IDENTIFYING EFFLUENT PLUMES

I THE MACROSCOPIC POINT OF VIEW

There are three basic points of view assumed by the science of air pollution control in identifying and evaluating emissions of contaminants. These are the microscopic, the macroscopic and the megascopic. In the field of air pollution control these points of view are assumed by the chemist, the inspector or control engineer and the meteorologist, respectively.

The *microscopic* point of view is fundamental to a scientific understanding of all air pollution phenomena. The scientist here is primarily interested in the properties and behavior of the smallest units of air pollution measurable by instruments and techniques of scientific analyses. He identifies, classifies and measures concentrations of the individual units. With the knowledge thus compiled, the researcher not only provides information adequate to the definition of problems and descriptions of air pollution phenomena, but he will be able to measure, analyze and evaluate air pollution trends.

The *macroscopic* viewpoint is that which can be accurately inferred by means of direct, first-hand observation through utilization of the senses of sight, smell, hearing, and touch. Such direct first-hand observers are represented mostly by the field inspector and the control engineer. They are both interested in such operational techniques, equipment, designs, and control devices as may be effectively employed – not only for collecting and reducing the total emissions of contaminants but also for controlling contaminants which cannot be observed with the naked eye. The macroscopic viewpoint also includes assumptions of microscopic phenomena made from clues perceived by the direct senses, together with expert knowledge of air pollution problems. The application of such understanding to a current problem – in this case, air pollution – is known as apperception.

On the face of it, it would appear that all the inspector need do in observing specific air pollution problems is to be able to demonstrate that what he observes *is* an air contaminant, that is, a plume or effluent which is not water vapor or a natural constituent of the atmosphere, and that the emission constitutes a violation of some standard. Many regulations or prohibitions do not require the enforcement officer to identify specific contaminants.

However, the only certainty that an air contaminant is involved is through identification and measurement. The specific identity of the air contaminant is also important to those responsible for source control. The inspector cannot report or testify on his observations unless he understands what he sees.

While the specific contaminants in such effluents as smoke can be assumed, in more complex instances the contaminants in a plume can only be inferred from an analysis of fuels, processes, operation and equipment design. The inferences made from these operational and maintenance practices comprise the engineering analytical approach that must be taken by both the field inspector and the control engineer.

The *megascopic* view is the expanded, magnified, or extrapolated view of air pollution depicting the chemical and physical behavior of the entire air pollution cloud in the pollution zone. It is the statistical effects of both microscopic and macroscopic phenomena, the total complex of air pollution emissions and the atmospheric reactions which take place in the air. The foremost megascopic discipline applied to air pollution in this regard is the science of meteorology.

The field inspector is not directly concerned with the megascopic view although he must understand it. The inspector is primarily interested in individual air pollution problems. He is concerned with the megascopic in a practical way, however, whenever the air pollution "configuration" described below is so protracted as to envelope a general community.

The three points of view described above are not mutually exclusive. The chemist or researcher may also be interested in the meteorology in determining concentrations of contaminants which may be reached. The inspector or engineer, as we have stated, is taking an analytical approach to specific air pollution problems, looks for visible clues, evidence or indications, from which reasonable assumptions of microscopic behavior can be drawn. The criterion here, however, is one of perception. By and large, the inspector conducts field observations directly by means of his direct senses and his knowledge of air pollution.

In the macroscopic point of view, there are two essentials to the identification and, subsequently, the evaluation of field observations made of source emissions. These are (1) the particular "configuration" or "gestalt" of any specific air pollution situation, all elements of which are necessary to a complete, coherent understanding of what is happening. It is, in essence, the story of any air pollution problem ("who, what, where, when, how, why"); and (2) the identification of the effluent formation and, possibly, its composition. This procedure should be adequate for the identification of the observed emission and the proof that it is an air contaminant.

A. The Air Pollution Configuration

The air pollution configuration is represented by the entire cycle of cause and effect and is composed of identifiable stages. The configuration described here, it should be noted, approximates the elements of a corpus delicti or a crime discussed in Chapter 13.

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1 The possible, probable or direct cause of the air pollution emission in terms of equipment, operation, design, maintenance, fuels, or material fed.

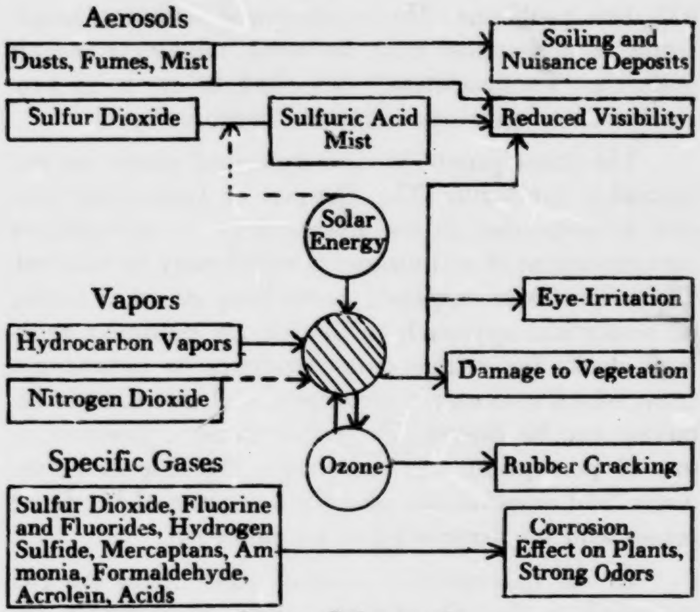
2 The air pollution plume or effluent as emitted, and rate or quantity.

3 The possible contaminants in the emission.

4 The effects of the contaminants in the atmosphere—clouds, hazes, reduction of visibility, photochemical effects, etc.

5 The effects of contaminants on life and property such as odor, corrosion, toxicity, deposits and eye-irritation.

Insofar as stages 3 to 5 may not always be readily deductible by direct sense perceptions, the inspector may make assumptions from his knowledge which can be borne out later by actual source testing or by an expert in the given field. For example, he is aware of the principal types of atmospheric contaminants and their effects as shown below:



Source: *Reference* 4.

Figure IX-1. Relationship of contaminants to contaminant effects.

The inspector in the field, of course, may not always be able to connect cause with effect. In many situations he may have to rely on source testing and on general research activities. However, he should be prepared to make some approximate description of each stage or element in the entire air pollution situation. Particularly must he be able to identify the form of the effluent emission, i.e., smoke, fumes, dusts, mists, gases and vapors.

II EFFLUENT FORMATION AND COMPOSITION

An *effluent* of air contaminants is a colloidal system, i.e., a suspension of particles in the air or other gaseous medium, or a gaseous mixture released as a *plume* from a specific source outlet. Contaminant plumes may be either visible or invisible to the naked eye. Visible effluents are those which consist of any one or combination of the following contaminants:

1) A sufficient concentration of a colored contaminant gas, such as nitrogen dioxide (brown to yellow), bromine (reddish-brown), iodine (purplish) and chlorine (greenish-yellow). With the exception of these gases, however, virtually all contaminant gases significant in air pollution are colorless.
2) Aerosols seen by light-scattering greater than .4 micron.

In the case of aerosols, the visual threshold is dependent upon the intensity and the direction of the light source with respect to the observer, and the position and concentration of the effluent. The maximum visibility reduction occurs when the light source is directly opposite the observer and behind the effluent. As the observer changes his angle of position, the visual effect of the light scattering diminishes until, at a change of 180° of position, the visual effect is nil.

Effluents are invisible when the aerosols cannot be seen with the naked eye, or they consist of colorless gases, or the concentrations of visible materials are too low to be detected by the naked eye.

For purposes of definition here there are three basic types of emissions which may be observed by the inspector.

A. *The Plume or Effluent*

The plume or effluent (Figure IX-2) is the flow itself of the contaminant-laden gas stream from a specific outlet such as a stack or vent. The plume, particularly when it is distinctly visible, is characterized by (1) a point of release and formation just at the outlet of a stack or opening of a closed system, or a few feet above the outlet in the case of a "detached" plume, (2) the body or stream, comprising most of the contaminants carried by the momentum of the escaping gases, and (3) the point at which the plume or effluent dissipates.

The breakdown of the plume structure is important. The point of discharge of the emission, or the point of maximum opacity, is the point at which the opacities of visible emissions are read or sampled. The stream or body of pollution provides some relative notion of quantity and velocity of the escaping contaminants, as well as other characteristics such as color and particle size which help identify the plume. The point of dissipation is also important in determining whether or not the plume is a contaminant, water vapor or steam, or some combination of both. Depending on wind velocity, humidity and temperature, water vapor or steam tends to dissipate more rapidly than any contaminants contained in the effluent. The greater the humidity, generally speaking, the longer will be the steam plume. Where most of the effluent appears to consist of water vapor, the opacities or densities of the contaminants are read at the point of dissipation or evaporation of the steam.

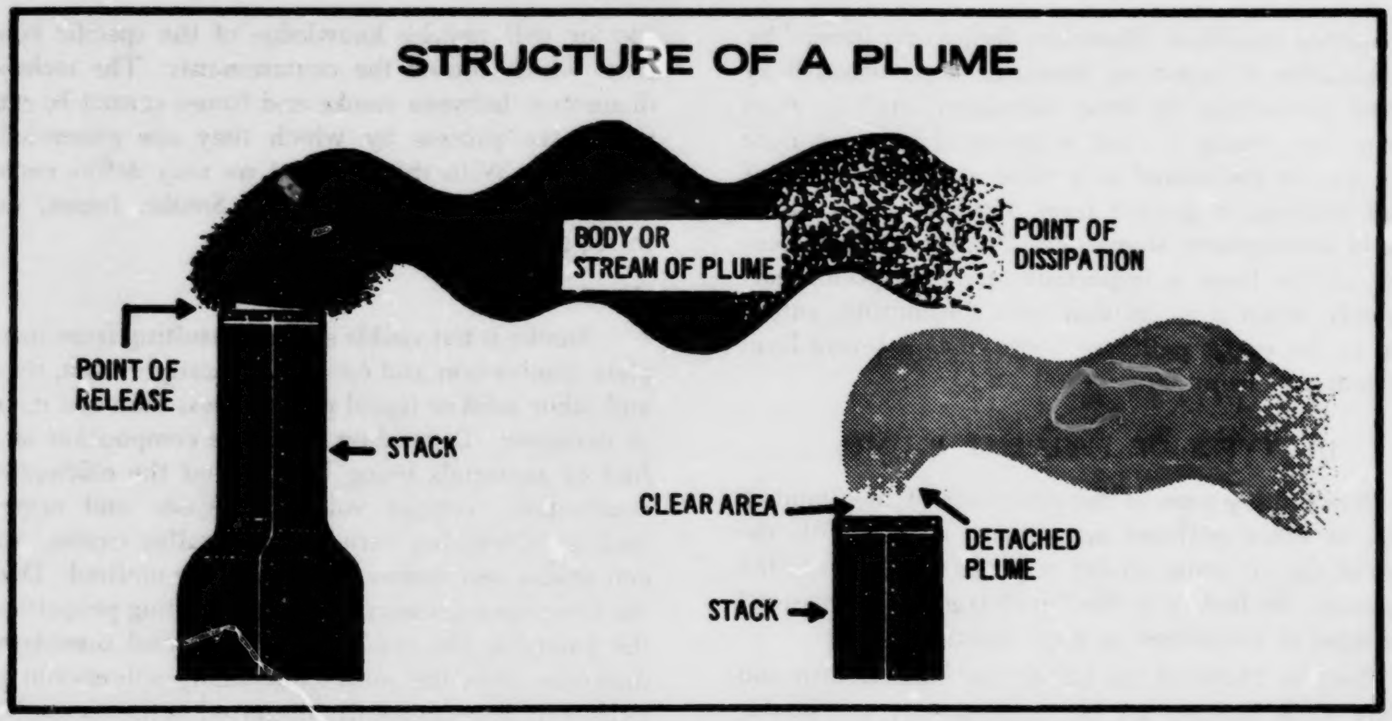


Figure IX - 2. General structure of continuous and detached plumes, respectively. Emissions are read at points of maximum opacities.

General atmospheric conditions may also be indicated by the behavior of the plume, and may be of significance in assessing a nuisance potential. A plume which rises straight up, for example, indicates rapid vertical mixing of contaminants favorable to the dispersion of the contaminants. Horizontal plumes, however, may cause fumigation of an area down-wind from the source of emission. The direction and extent of diffusion may then be indicated by the type of plume. A plume which disperses both vertically and laterally is known as a *coning* plume, in that the shape of dispersion is in the form of a cone. A coning plume generally results when wind speeds are in excess of 20 miles per hour. A *looping* plume occurs in turbulent or gusty atmospheres, and in general, results in good dispersion and only sporadic fumigation. A *fanning* plume generally results from a steady, and sometimes, slow wind stream, and tends to maximize the area of effective fumigation possible at relatively high contaminant concentrations.

In most cases, a trained observer can distinguish between smokes and fumes by color, behavior and dissipation point. Since a fume consists of relatively heavier molten liquid droplets which condense rather rapidly to a solid or mist, the point of dissipation is often closer to the stack outlet than in the case of smoke particles. Also, fume plumes often tend to form hazes sooner than do smoke plumes.

An experienced observer can also distinguish between emissions of smoke resulting from rubbish burning, fuel-oil burning, and even natural gas, when gas-fired boilers are severely out of adjustment, by color and escape velocity of the body of the plume.

Of course, these generalizations must be supported by a thorough inspection of equipment and processes, and by any source testing which may be required in delineating the air pollution configuration.

Invisible plumes, i.e., escaping gas streams, can frequently be inferentially detected by sound of gases escaping from high pressure systems and light refraction (shadows cast by evaporating vapors) from low pressure systems. Some gases, like butane or propane under high pressure, can be detected by frosting at the point where the pressure drop occurs at the valve and still others by physiological responses on the part of those near the source. Gases may be detected by odor or by irritation or pressure on mucosa.

B. *The Cloud*

A cloud of air pollution is an emission of air contaminants which has become completely divorced from its source or sources and is gradually being dissipated by the processes of dilution, sedimentation and diffusion, but still retains a distinctly visible shape. The cloud is shaped by the direction of air flow, and by dilution which occurs at right angles to this flow. The cloud is the extension, or the fanning effect of the plume and generally occurs under conditions of relative atmospheric stability. Clouds are often produced from large source emissions and from building, brush and forest fires. Generally speaking, the larger the quantity of air pollutants, the longer the cloud remains.

Noting the appearance of clouds in reports, especially as to height, length, breadth and thickness can be of importance in determining the severity of a general or local problem.

C. *The Haze*

The air pollution haze is sometimes similar in appearance and behavior to a light fog in that it is a widespread condition. Hazes are frequently formed by condensation of vapors on atmospheric particles, or by aerosol production in smog formation, and by dusts and pollen. Smog is itself a chemical haze. A haze may also be considered as a more attenuated form of cloud residing at ground level, representing a condition of atmospheric stagnancy. Notation of the existence of the haze is important to the inspector particularly when it is peculiar to a community, rather than to the entire pollution zone, since a severe local problem may be present.

III TYPES OF EFFLUENT PLUMES

Since the plume is the precursor of the cloud or haze, or other polluted air stream, it represents the form of the air contaminant of primary interest to the inspector. In fact, it is the "discharge" or "emission" regulated or prohibited in most statutes or rules.

Section 24208 of the California State Health and Safety Code defines an air contaminant as "smoke, charred paper, dust, soot, grime, carbon, noxious acids, fumes, gas, odor, or particulate matter or any combination thereof". This particular definition, however, does not classify air contaminants in practical and definable categories, but identifies familiar contaminants. Since these contaminants are not necessarily mutually exclusive, they tend either to be synonyms of one another or to represent a common class of pollutants. Thus, particulate matter may be inclusive of soot and acids; and carbon, a chemical element, is also included in the term smoke. The legal definition, though inconsistent in terms of a definitive classification system, however, is practically inclusive of all known air contaminants, if an air contaminant is considered to be any substance which is foreign to the natural composition of the atmosphere. As a matter of fact, gases and particulate matter in the definition alone can be used as a basis for classifying all known contaminants.

Since all substances become liquid, solids and gases at certain temperatures, any effluent or plume will consist of a variety of contaminants in various states of matter. Smoke, for instance, may consist chiefly of aerosols — carbon particles and solid or liquid particles (acids and aldehydes) of partially burned fuels — but may also consist of such gases as sulfur dioxide, oxides of nitrogen, or unburned vapors generated in the gaseous state.

Here, again, the identity ascribed to the effluent is generally made in terms of its outstanding visual characteristic. For example, even though sulfur dioxide may be the most significant of the pollutants emitted from a stack, the effluent in which it is contained is frequently described as smoke due to the visible soot, carbon particles and fly ash also contained in the plume.

The mere observation of a plume, however, does not result in its conclusive identification. The inspector will require knowledge of the specific conditions which caused the contaminants. The technical distinction between smoke and fumes cannot be made unless the process by which they are generated is described. With this in mind we may define each of the six categories of effluents: Smoke, fumes, dust, mists, gases and vapors.

A. Smoke

Smoke is the visible effluent resulting from incomplete combustion and consisting mostly of soot, fly ash and other solid or liquid particles less than one micron in diameter. Depending upon the composition of the fuel or materials being burned and the efficiency of combustion, various volatilized gases and organics such as aldehydes, various acids, sulfur oxides, nitrogen oxides and ammonia may also be emitted. Due to the low vapor pressures and slow settling properties of the particles, the smoke may be carried considerable distances from the source and many sub-micron particles will be permanently dispersed in the air medium.

When complete combustion occurs, only carbon dioxide, water vapor and small amounts of ash are emitted. Thus the generation of smoke depends on the efficiency of combustion equipment in relation to the fuel or material being burned. Whether such combustion devices are incinerators, boilers, afterburners, etc., their design and operation must accommodate the entire burning cycle — (ignition, burning and burndown) by means of providing for the following:

1. Temperature high enough to ignite and burn all of the material.
2. Sufficient time to allow complete burning of all of the fuel or material.
3. Sufficient turbulence to permit thorough mixing of fuel particles with combustion air.
4. Sufficient oxygen for a proper air-fuel ratio. An excess of air, it should be noted, can cause smoking due to cooling.

Smoke will vary in color, but will be generally observed as grey, blue, black, brown and white, and sometimes yellow, depending upon the conditions under which certain types of fuels or materials are burned. The color of smoke is generally a fairly good indication of the type of combustion problem encountered.

Smoke which is grey or black in color may indicate that the material is being burned with insufficient air or inadequate mixing of fuel and air.

White smoke usually results when the fire is cooled by excessive drafts of air, and may also be generated when the materials being burned contain excessive amounts of moisture.

Brown or yellow smoke may result from the burning of semi-solid tarry substances such as asphalt or tar paper, resulting from inadequate temperature and mixing.

BOILER TYPES

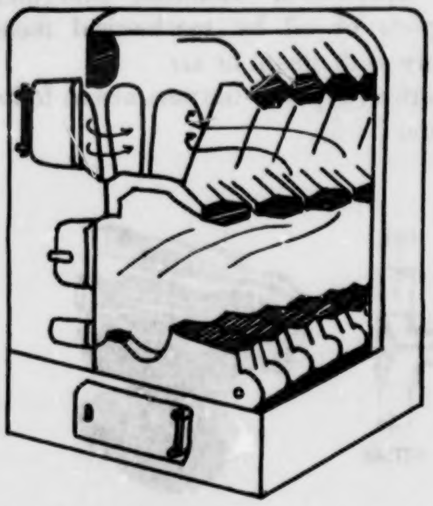


Figure IX - 3. Cast-iron sectional boiler.

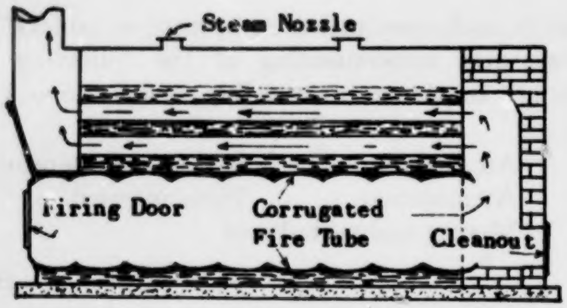


Figure IX - 4. Scotch Marine boiler.

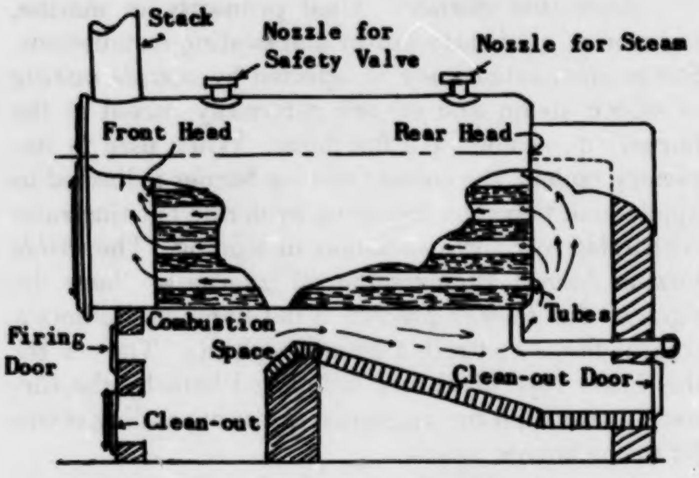


Figure IX - 5. Horizontal return-tubular boiler.

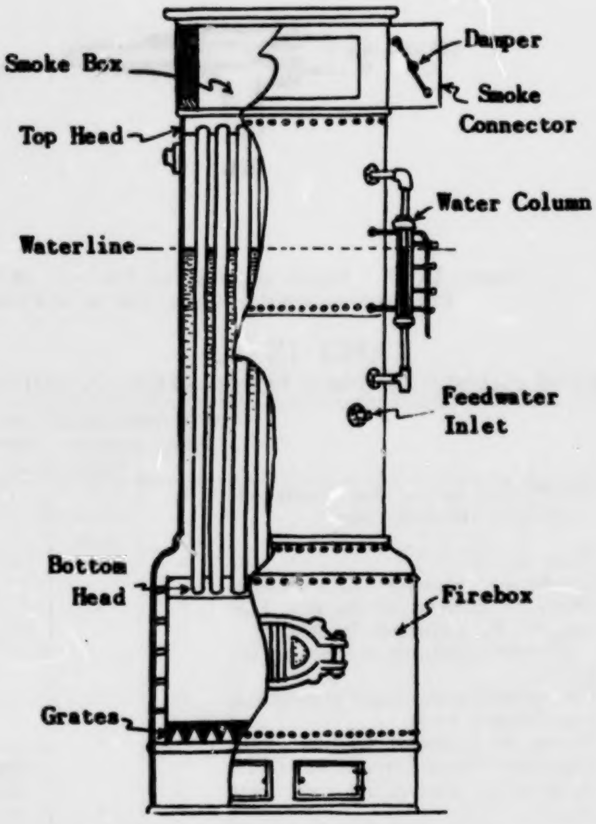


Figure IX - 6. Vertical tubular boiler.

Water-Tube: Water conveyed by tubes is surrounded and heated by hot gases.

Fire-Tube: The tubes, surrounded by water, convey hot gases and serve as heating elements.

Horizontal Return-Tubular: Commonly used in small power plants. The gases from the furnace, after passing below the boiler along the outside of the shell to the rear, return through tubes to the stack connection at the front of the shell.

Vertical Tubular: This type of boiler requires small floor space per boiler horsepower, and furnishes superheated steam. Small boilers range from 3 to 100 h.p., and large boilers range from 50 to 500 boiler horsepower.

Scotch Marine: Combustion chambers are internally fired, are entirely surrounded by water, and are located at the rear end of the furnace. This is a variation of the fire-tube type boiler.

Cast Iron Sectional: A radiator type boiler consisting of a series of water jackets which are heated by the furnace.

Gas-Fired Boilers: Boilers fired by gas alone, and not employing supplementary solid or liquid fuels, do not normally create air pollution problems since complete combustion is achieved. During the adjustment period of a new gas-fired boiler, however, there may be occasional emissions of smoke.

A blue color or light blue color is often associated with the burning of domestic trash consisting mostly of paper or wood products. The light blue color seems to stem from the fine particles of pyroligneous acid from sulfide treated paper and wood tar in the material. The blue plume contains little or no carbon or soot particles.

We may consider briefly here the principles of combustion as they apply to (1) the combustion of liquid fuels in process and heating equipment such as boilers; and (2) the combustion of rubbish and other waste materials in incinerators.

1. Fuel-Oil Burning

Because of the tremendous quantities of oil burned, contaminants such as oxides of sulfur, oxides of nitrogen, and soot particles can become significant as emissions from large oil-burning installations even though a maximum degree of control is practiced. For this reason, operation and maintenance factors are critical in such combustion equipment as boilers. Observance and understanding of the following five factors are important in avoiding smoke: (See Table IX-1).

Air-fuel ratio	Ignition temperature
Atomization	Time interval
Mixing and turbulence	

The oil burner prepares fuel for complete and rapid combustion. The oil is not burned in a liquid state but is vaporized or "atomized" into finely divided liquid droplets of oil by mechanical means or by inter-mixture with steam or air.

The various types of burners are as follows: (Figures IX-7 and IX-8).

BURNER TYPES

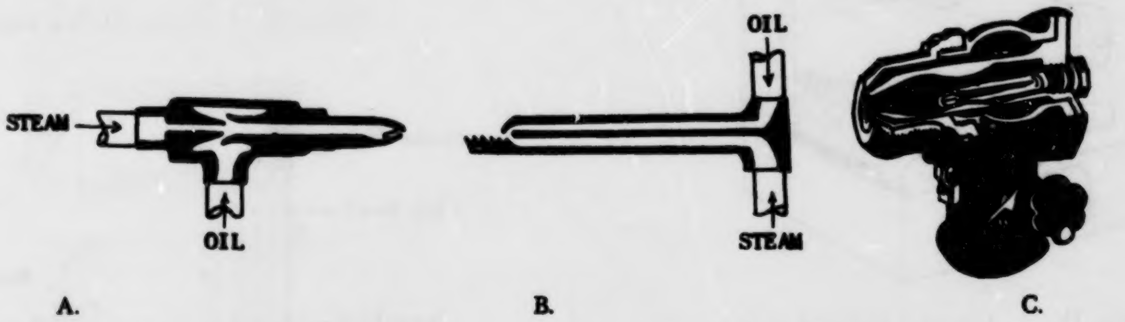


Figure IX - 7. Simple steam-jet oil burners: (A) inside-mixing burner, (B) outside-mixing burner, (C) Hauck low pressure inside-mixing type oil atomizing nozzle.

TABLE IX — 1

COMMON CAUSES OF POOR COMBUSTION IN BOILERS

	SMOKING FIRE	CARBON FORMATION	FIRE PULSATES
1. Insufficient air or too much oil (Improper air-fuel ratio).	x	x Sometimes	x
2. Poor draft.	x	x	x
3. Excess air (causing white smoke)	x		
4. Dirty or carbonized Burner Tip (caused by improper location insufficient cleaning at regular intervals).	x	x	
5. Carbonized or damaged atomizing cup (rotary cup).	x	x	
6. Worn or damaged Orifice Hole	x	x	
7. Improper burner adjustment (diffuser plate protruding improper dist.).	x	x	Sometimes x
8. Oil pressure to burner too high or low.	x	x Sometimes	
9. Oil viscosity too high.	x	x	
10. Oil viscosity too low. (too high fuel oil temperature)		x	x
11. Burner is being forced (especially after initial light-off or when combustion space is relatively cold).	x	x	x
12. Insufficient atomizing steam.	x	x	x
13. Water in fuel oil.	x	x	x
14. Dirty fuel oil.	x	x	x
15. Fluctuating oil pressure.	Intermittent x		
16. Incorrect furnace construction causing flame and oil impingement.	x	x	
17. Carbon clinker on furnace floor or walls.	x	x	
18. Incorrect atomizer tip size.	x	x	
19. Condensate in atomizing steam.	x		x
20. Atomizing steam pressure too high.			x
21. Furnace cone angle too wide.	x		x
22. Furnace cone angle too narrow (making it necessary to have atomizer in maximum position).	x	x	x
23. Atomizer not immediately removed from burner after being secured.			

Source: *Reference* 8.

Atomizing Burners. Used primarily in marine, locomotive, stationary power and heating installations. Steam atomization may be effected by *outside mixing* in which steam and oil are externally mixed at the burner tip, producing a flat flame. When used in stationary boilers, the *outside mixing* burner is limited in application to boilers requiring moderate burning rates with relatively little variation in loading. The *inside mixing burner* atomizes the oil internally. Some designs of this burner produce a flat flame and others a conical flame controlled by air registers. The air for this latter type of burner is induced both by the furnace suction and the aspiration of the expanding steam jet in the burner nozzle.

The oil temperature required at the entrance to the burner to give a suitable viscosity for atomization is usually between 150 and 200°F. (unless the oil is of a low viscosity and does not require preheating) and the steam supplied to the jets ranges from 25 to 80 pounds per square inch gauge.

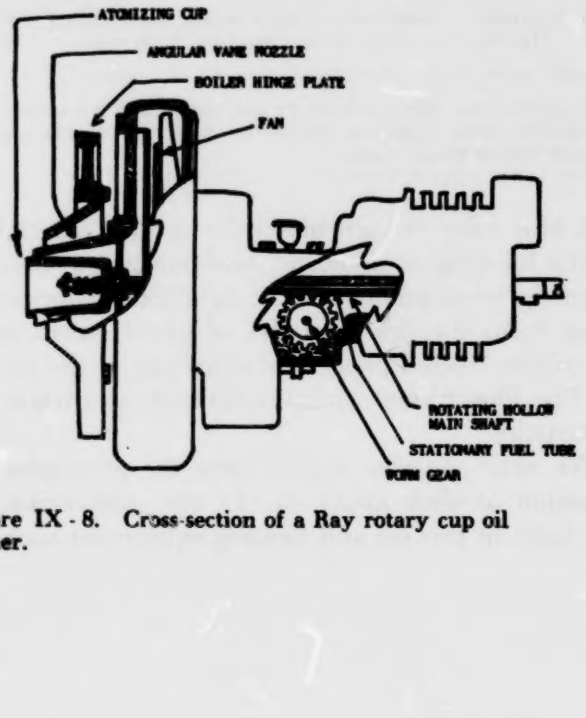


Figure IX - 8. Cross-section of a Ray rotary cup oil burner.

Mechanical Atomizing Burners are either of the *rotary cup* or *spray nozzle types*, for which no atomizing fluid is used. The *spray nozzle* type is usually used with power plant steam generating units. The oil in this type of burner is sprayed from a small nozzle under its own pressure, (30 to 300 pounds per square inch gauge, 10°F. to 350°F.). The spray passages are so designed as to give a whirling motion to the spray as it emits from a small orifice which is concentric to its axis of rotation. The flame issues as a hollow cone.

In the *rotary burner* the oil is fed through a hollow rotating shaft on the end of which is usually a hollow cup which throws the oil from its edges in the form of small particles. Rotary or "centrifugal" burners are used only in small low pressure installations.

Should the operator neglect or fail to control any one of the five factors, boiler efficiency and economy will be lowered, and excessive smoke may result.

When "lighting-off" (firing) a cold boiler, the operator should take these measures: (8)

1. Open stack damper and air registers (allow sufficient time for any accumulated gases to be dissipated).
2. Recirculate fuel oil until proper temperature is reached at the burners.
3. Insure sufficient oil pressure on the burner header line.
4. Thoroughly blow out all condensate in the atomizing steam line (make sure atomizing steam to burner is dry).
5. Be sure that burner to be used in "lighting-off" is clean.
6. Use small orifice tips (pressure burner).
7. Only *one* burner (on boilers fitted with multiple burners) should be used until refractory is relatively hot.
8. Use most centrally located burner during the initial period.
9. Allow sufficient time to bring cold boiler up *very gradually* to operating temperature and pressure. (2 to 3 hours for water tube boilers and 8 to 10 hours for fire-tube boilers. This time may be less for smaller boilers.)

2. Incineration

Incineration is a practice which disposes of waste materials through combustion. An incinerator is essentially a heat-resistant enclosure providing for the introduction of combustion air either through the bottom of a grate supporting the charge (underfire), or through port openings across the surface of the fuel bed (overfire). In its simplest form, the incinerator consists of a combustion chamber, an ash chamber and a smoke stack. With respect to efficient and smokeless combustion, incinerators are classified as *single* and *multiple chambers*. Both types of incinerators may involve auxiliary aids to combustion such as gas or oil burners, forced draft blowers, continuous feed systems, movable grates, ports, doors and dampers for control of secondary air, and spark arrestors.

A single-chamber incinerator is a device in which one chamber serves ignition, combustion and ash removal, partitioned only by a fixed or movable grate. Since this type of incinerator fails to provide the conditions necessary for complete combustion — it is quite often nothing more than an enclosed open fire — the control of smoke, volatilized gases (fumes) and fly ash in its operation is uncertain. Single-chamber incinerators are variously designed for domestic, commercial and industrial waste disposal, and fall into the following categories:

1. Small residential concrete-slab incinerators. (Figure IX-9).
2. Intermediate box-type or Dutch-oven types for commercial and medium sized industrial establishments (Figure IX-10).
3. Flue-fed incinerators for apartment houses. In these the smoke flue also serves as a depository for rubbish (and sometimes garbage) at the respective floors of the apartment house (Figure IX-13).
4. Large silo, cyclone-fed incinerators designed for continuous burning of industrial wastes, most notably from the wood-working industries (Figure IX-11).
5. Large municipal oven-type incinerators designed to accommodate large quantities of miscellaneous rubbish (Figure IX-12).

Needless to say, mo[illegible]gle-chamber incinerators are not designed to cont[illegible] smoke, but to dispose of rubbish. As a consequence, the widespread use of these incinerators in a large metropolitan area causes significant amounts of smoke pollution. The control of incinerators is essentially the finding of a suitable means for rubbish disposal or more efficient types of combustion equipment. The problem of rubbish burning in Los Angeles County was controlled through the elimination of open burning dumps in 1950, the elimination of all types of open fire refuse burning in 1955, elimination of all industrial waste disposal in single-chamber incinerators in 1957, and finally, a ban on all single-chamber incinerators. The rubbish problem was largely resolved by disposal in cut-and-cover dumps.

Multiple-chamber incinerators are designed for the purpose of providing efficient and maximum combustion of the materials being burned, and hence less emissions of smoke, fly ash and volatilized gases over a wide (though limited) range of operating conditions. The multiple-chamber incinerator is constructed in a series of three chambers interconnected by flame ports: (1) a charging or "ignition" chamber for the initial light-off and burning of the material, (2) a "mixing" chamber providing the turbulence and temperature necessary to consume incompletely burned or organic

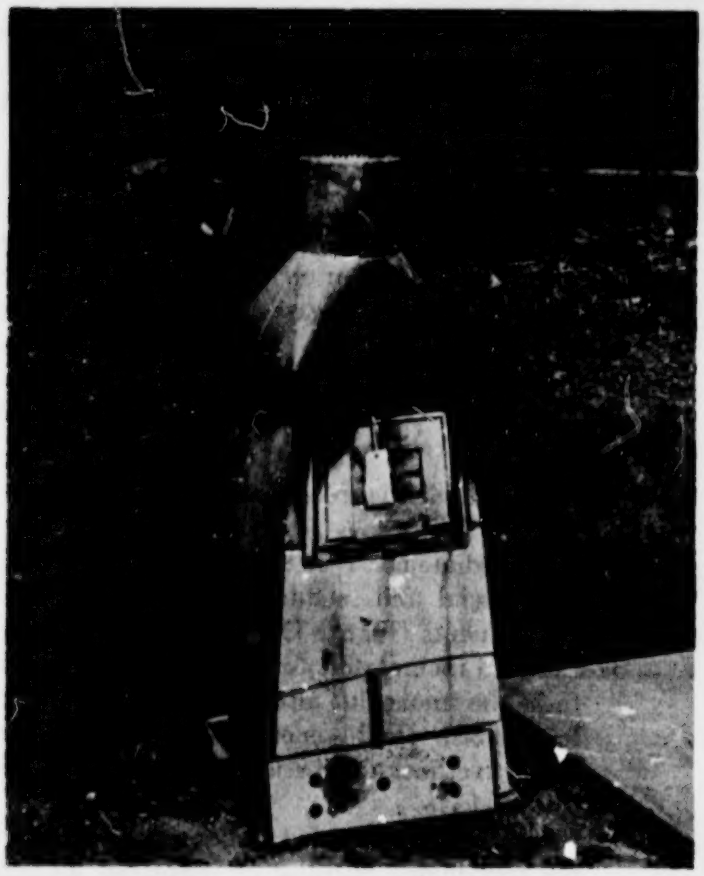


Figure IX - 9. Backyard concrete-slab, single chamber incinerator.

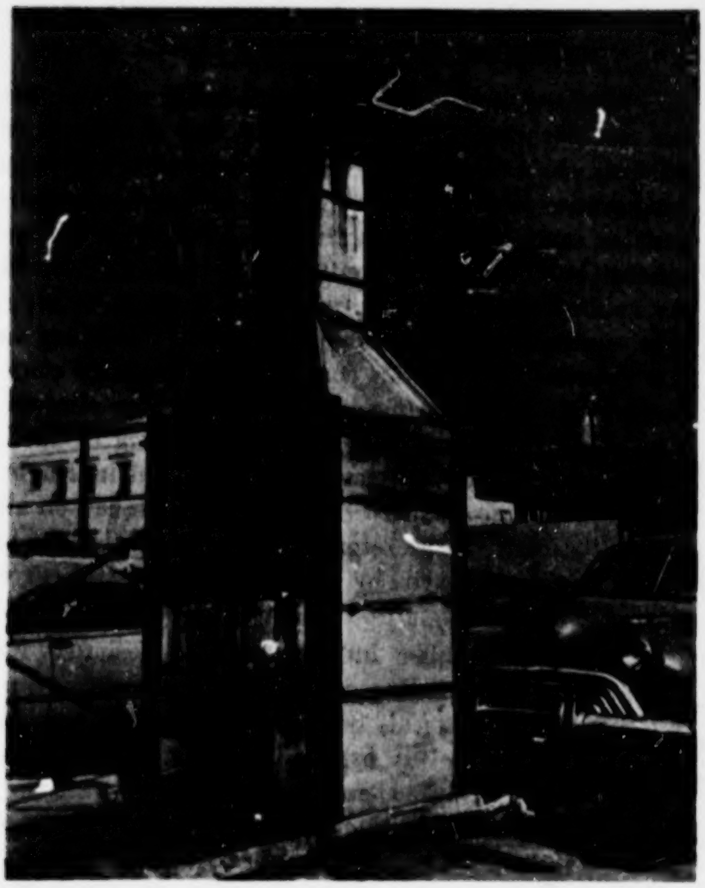


Figure IX - 10. Commercial box-type incinerator.

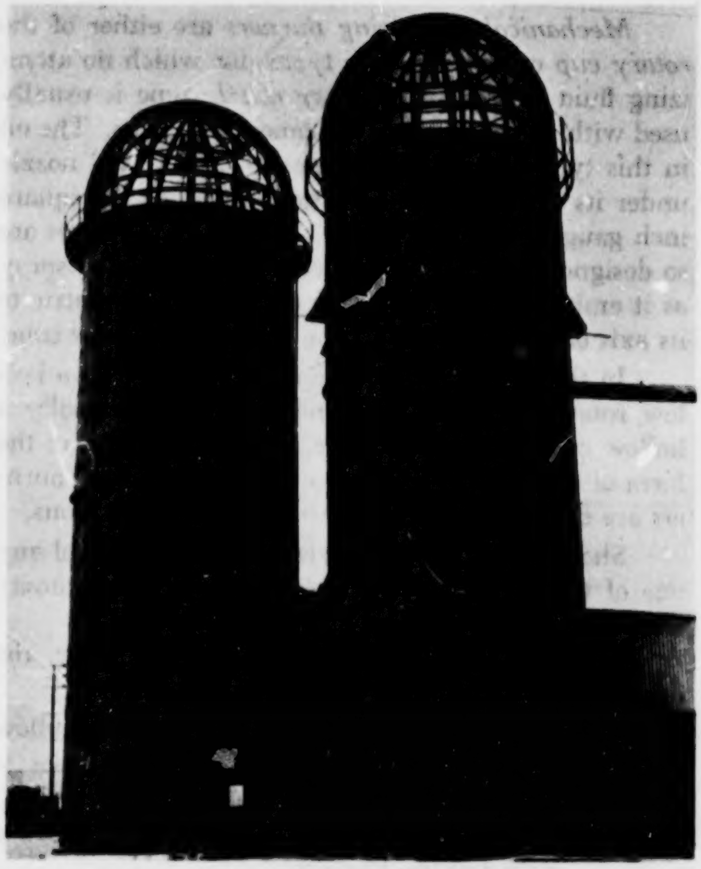


Figure IX - 11. Cyclone-fed, silo-type wood-burning incinerators.

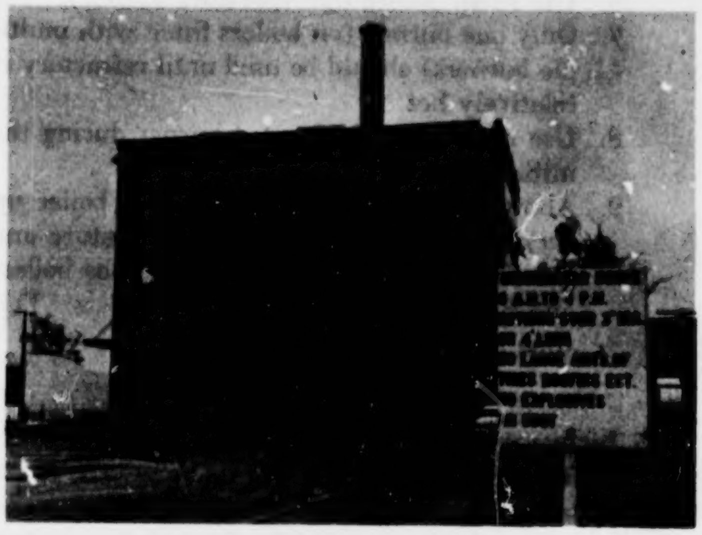


Figure IX - 12. Municipal incinerator.

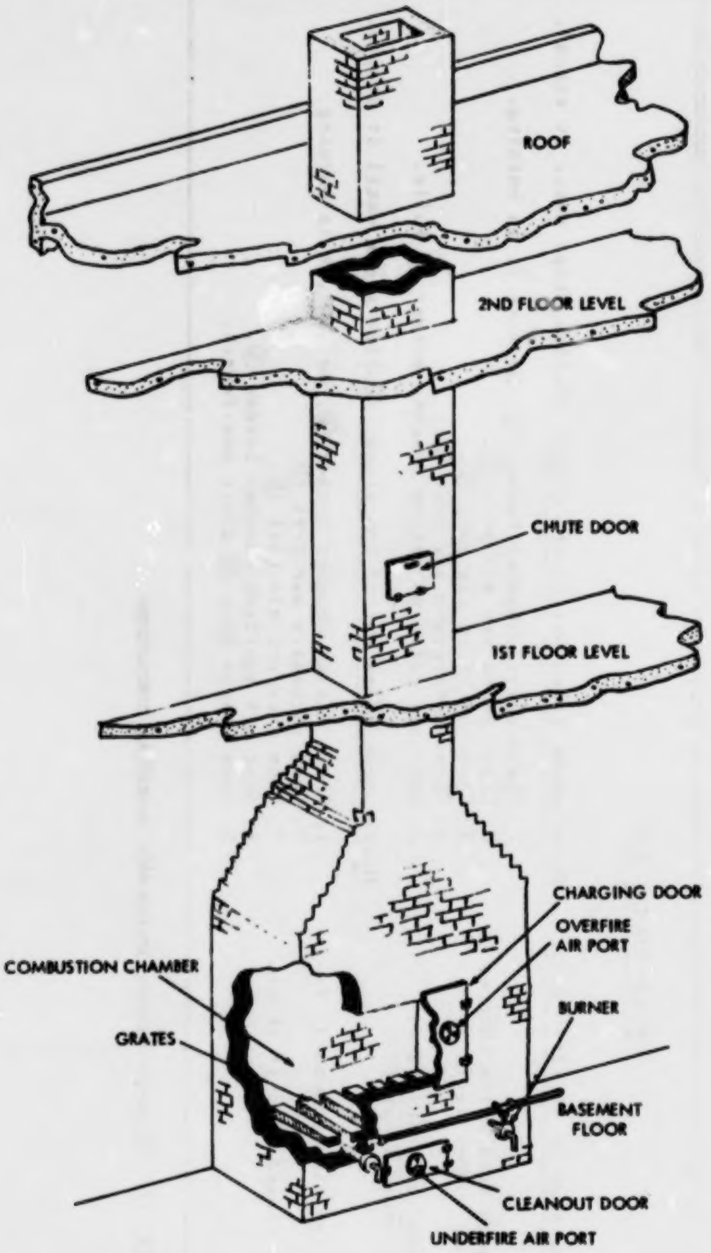


Figure IX - 13. Uncontrolled flue-fed incinerator.

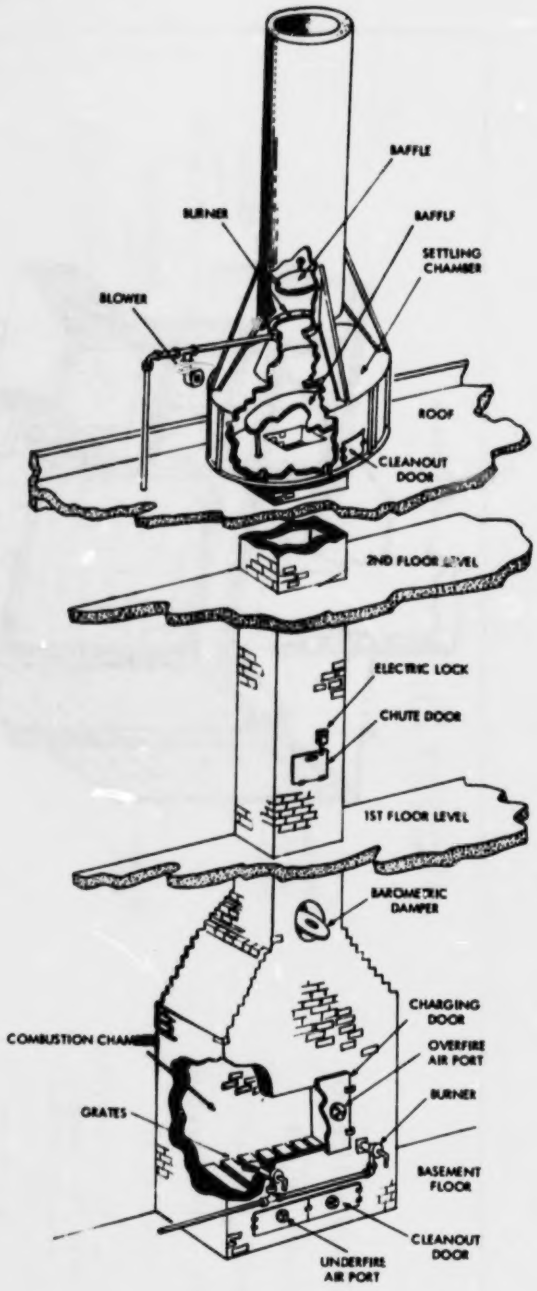


Figure IX - 14. Flue-fed incinerator controlled by a roof afterburner, settling chamber and barometric damper.

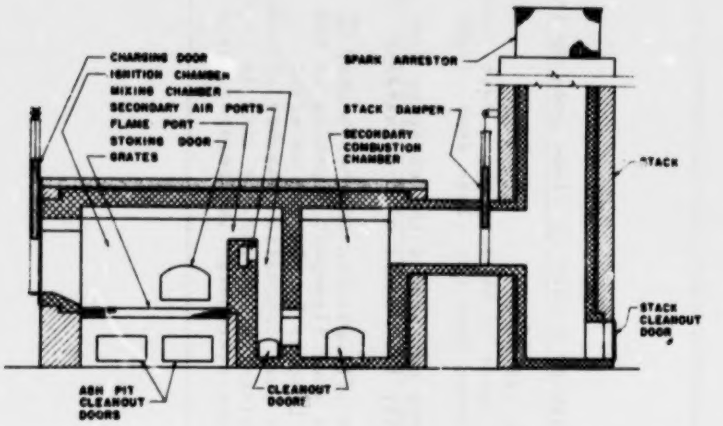


Figure IX - 15. Diagram of a large multi-chamber "in-line" incinerator.

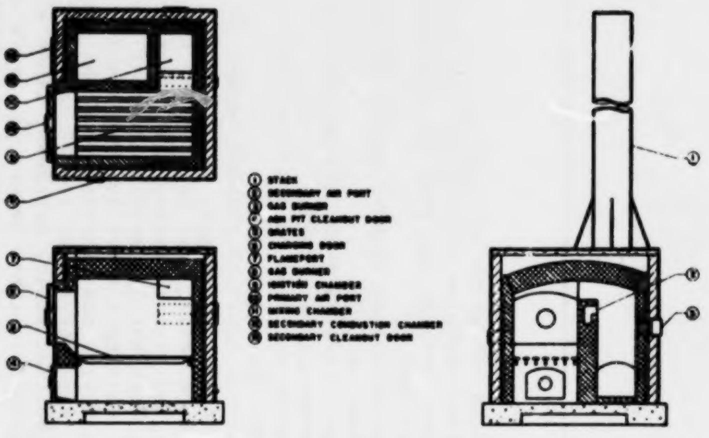
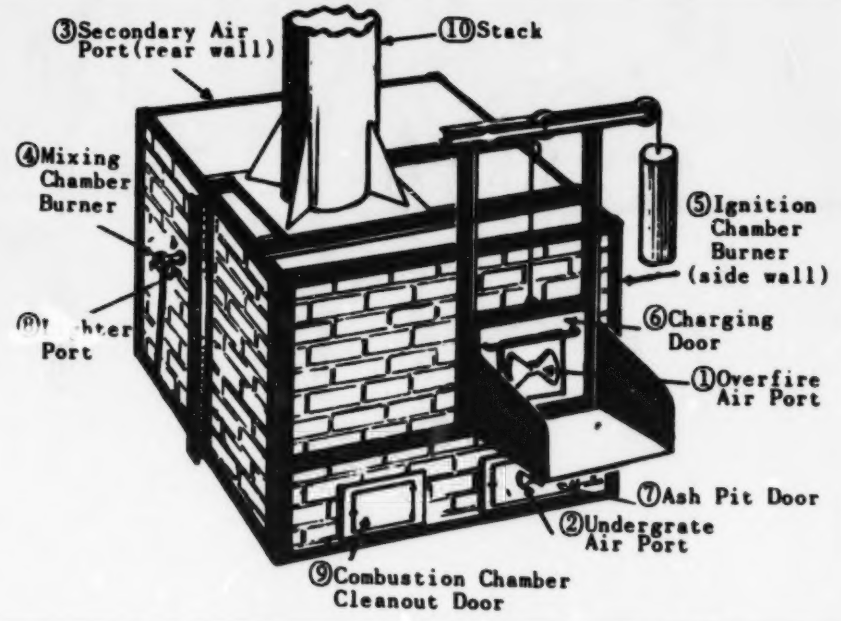


Figure IX - 16. Diagram of a small multiple-chamber "retort" incinerator.

1. Clean out grate and ash-pit.
2. Close charging door ⑥ and ash pit door ⑦.
3. Open overfire air port ①, secondary air port ③ and undergrate air port ②.
4. Ignite mixing chamber burner ④ through lighter port ⑧ and close port ⑧.
5. Open charging door, charge material to fill chamber one-half to three-quarters full.
6. Ignite material on grate at top rear of pile and close charging door ⑥.
7. Turn on ignition chamber burner ⑤ only if very moist or wet material is charged.
8. Before adding more material to the burning pile in the incinerator
    a. Wait until burning pile fills less than one-half the chamber.
    b. Push burning pile to rear of grates. (Do this gently, without causing bits of burning rubbish to fly off the pile).
    c. Charge new material on front portion of grates. Do not put new material on top of the burning pile.
9. Operation during burndown. Close all air ports ① ② ③. Ignite ignition chamber burner ⑤, leave it on until only ash is left on grate. Leave mixing chamber burner ④ on until all smoking of material on grate is stopped, then shut it off.



WHAT TO DO IF:

Mixing chamber burner ④ flame goes up instead of down when it is first lit.

1. Shut off burner.
2. Put piece of burning paper into incinerator through combustion chamber cleanout door ⑨, close door, light mixing chamber burner again.

Smoke comes out around the charging door or ash pit door or both. (This is normally the result of overcharging). (Follow steps until it stops).

1. Shut off ignition chamber burner ⑤.
2. Make sure flameport (opening at top rear inside ignition chamber), is not blocked by charged material.
3. Make sure combustion chamber cleanout door ⑨ is closed (and if it has a spinner or damper, be sure it is closed).
4. Do not overcharge incinerator again.

White smoke comes out of the stack. (Follow steps until it stops).

1. Check mixing chamber burner ④, be sure it is burning.
2. Close secondary air port ③.
3. Close overfire air port ①.
4. Close undergrate air port ②.
5. Open gas valve of mixing chamber burner ④ fully.

Black smoke comes out of the stack. (Follow steps until it stops).

1. Check mixing chamber burner ④, be sure it is burning.
2. Open secondary air port ③.
3. Open overfire air port ①.
4. Shut off ignition chamber burner ⑤.
5. Open charge door ⑥ about one-fourth.

Figure IX - 17. Multiple-chamber incinerator operating instructions.

materials, and (3) a combustion chamber for organic gases and the settling of fly ash. The multiple-chamber incinerator is constructed according to basic design principles in relation to the type of material and the rate at which it is being burned for the use intended. In particular, the relationship of grate loading to combustion rate and arch height to the grate area in the ignition chamber is considered to be critical(10) (12). Underfire air, which is normally used to obtain high fuel-bed temperatures in other types of combustion equipment, is minimized to prevent volatilization of inorganic materials. Overfire air, on the other hand, is used to promote surface combustion and to prevent ash entrainment. In addition, "secondary air" and additional flame coverage may be supplied to the mixing chamber when required.

There are two general types of multiple-chamber incinerators: the "in-line" type (Figure IX-15), usually used in the larger installations, and the "retort" type (Figure IX-16) usually used in the smaller installations. The portable type incinerator is of the "retort" type. This multiple-chamber incinerator was designed primarily to burn rubbish and wastes for contractors. Orange trees removed for the purpose of clearing land sites are often burned in these incinerators as well as construction materials such as wood waste, tar, tar paper, cardboard and other combustibles at the rate of 700 to 1000 pounds per hour.

Small units are considered to be those with design capacities in the range of 35 pounds to 1000 pounds per hour. The portable retort type is generally rated at about 450 pounds per hour of mixed rubbish.

Since the control of air supply and burner operation are not critical, multiple-chamber incinerators have an excellent, though not perfect, capability for smokeless combustion, and can be designed to operate in compliance with minimum permissible emission regulations, in particular Rules 50, 52, 53 and 54. However, to avoid occasional violations, certain precautions are necessary, particularly in the charging of the refuse to the incinerator.

> . . . The ignition chamber should be filled to a depth approximately one-third to three-quarters of the distance between the grates and the arch prior to lightoff. After approximately half of the refuse has been burned, the remaining refuse should be carefully stoked and pushed as far as possible to the rear of the ignition chamber. New refuse should be charged over the front section of the grates which was emptied by the moving of the burning refuse. To prevent smothering of the fire, no new material should be charged on top of the burning refuse at the rear of the chamber. Through use of this charging method, flames will cover the rear half of the chamber, fill the flame port, and provide nearly complete flame coverage in the mixing chamber. The fire will propagate over the surface of the newly charged material, spreading evenly and minimizing the possibility of smoke emission. If the refuse pile is not disturbed unduly, little or no fly ash will be generated (12).

Multiple-chamber incinerators can smoke excessively through careless operation, by exceeding rated capacities, by burning unauthorized materials, or through neglect of any of the conditions necessary for complete combustion outlined previously. When capacities are exceeded or flame ports are physically blocked, excessive smoke may occur from the stack or the charging doors. Some large multiple-chamber incinerators are designed to burn rubber insulated materials in large quantities and may be equipped with an additional ignition chamber for paper and wood wastes. Where two of such chambers are used, it may be necessary for both to operate close to rated capacities at the same time in order to eliminate smoke. If gas burners are involved, their operation may be required to assist combustion.

3. Other Sources of Smoke

We have briefly described the principles behind complete or incomplete combustion with respect to two types of common sources of air pollution. The principles enunciated here are sufficiently typical of other sources of smoke such as trucks, buses, automobiles, waste gas disposal systems, or wherever the effluent is a direct result of combustion.

B. Fumes

In air pollution control, fumes are referred to specifically as "condensed fumes". "These are minute solid particles generated by the condensation of vapors from solid matter after volatilization from the molten state, or may be generated by sublimation, distillation, calcination, or chemical reaction when those processes create air-borne particles."* Fume particles are generally less than one micron in diameter and will behave like smoke. Fumes will more commonly consist of metals and metallic oxides and chlorides. Also contained in the fumes are common solid particulates such as fly ash, carbon, mechanically-produced dust and gases such as sulfur dioxide. The fumes principally emitted, however, are actually dusts condensed from the more volatile elements in the metals melted such as zinc, sulfur, lead and others. The inspector, therefore, will probably be more concerned with metallurgical fumes, and frequently with emissions from galvanizing operations.

The metallurgical fume will consist primarily of the metallic oxide which is driven from the melting surface when metal is heated to the molten state. Metals such as copper and bronze with relatively high boiling temperatures, as compared to their melting and pouring temperatures, do not readily volatilize and do not constitute an air pollution problem. Copper and tin, for example, have boiling temperatures above 4000°F., but are poured at temperatures of about 2200°F. Some metals may contain alloys with extreme differences in volatility. Copper-based alloys such as

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* Los Angeles County Air Pollution Control District Rules and Regulations, Rule 2L.

Figure IX - 18. The relatively high volatility of zinc results in fuming when excessive melting temperatures are reached. (Zinc distillation furnaces).

yellow brass, manganese bronze, brazing spelter and various plumbing metals contain from 15 to 40 per cent zinc, the boiling temperature of which is around 2200°F. Since the metal must be heated to melt the copper which has the highest pouring temperature, a portion of the zinc will be brought to its boiling point and will volatilize. Copper alloys with high zinc contents may lose from 2 to 15 per cent of their zinc through fuming.

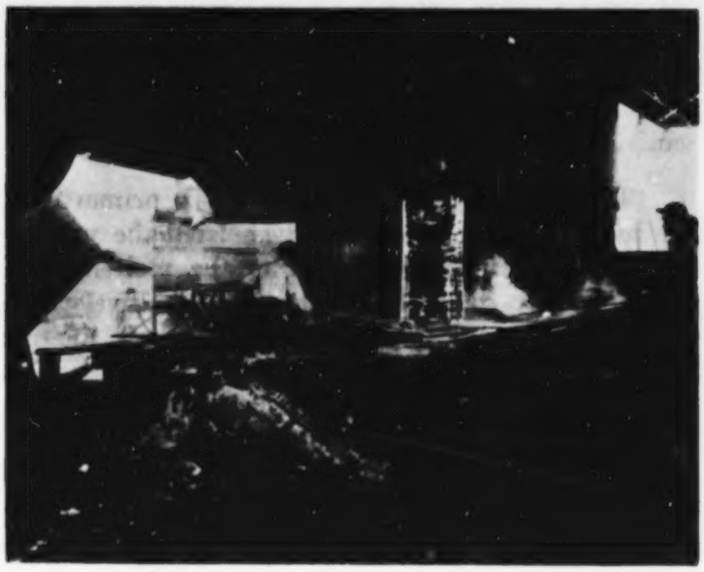

Figure IX - 19. Removal of tanks from fuming galvanizing kettle.

TABLE IX-2
RELATIVE VOLATILITIES AND MELTING TEMPERATURES FOR NON-FERROUS METALS

METALS	APPROXIMATE MELTING TEMPS.	RELATIVE VOLATILITY	FLUXES USED
Zinc Alloys	650°— 700°F	1	Ammonium chloride
Lead Alloys	600°— 650°F	2	Sodium Nitrate Sal amoniac Lump sulphur
Magnesium Alloys	800°— 900°F	3	Dow#1 and #2 Flowers of sulphur
Aluminum Alloys	1250°—1280°F	4	Chlorine gas Aluminum chloride Zinc chloride Aluminum fluoride
Copper Alloys (Manganese bronze)	Around 1800°F 1650°—2000°F	5	Silica sand blown with air Soda ash Borax

In brass and bronze melting operations (copper alloys), zinc is the first base-metal to fume because of its low melting temperatures in relation to copper. Copper alloys containing more than 5% zinc are likely to fume without proper controls. In particular, the following metals must be carefully controlled: Yellow Brass, 20% or more zinc; Manganese Bronze, up to 45% zinc; Brazing Spelter, 40% zinc; Plumbing Metals, 12% zinc. Copper alloys of less than 5% zinc content, such as Red Brass, are not likely to fume and may not require controls.

When vented to the atmosphere fumes have the appearance of smoke. However, all of the sources of fumes may not be practically vented in a large scale foundry operation so that fumes in the vicinity of a plant may appear as a haze or a cloud emitted from factory monitors and windows.

All foundry operations attempt to control fumes in some manner by the use of a flux or degasser which removes impurities from the molten metal. The impurities form a slag cover and prevent the volatilized material from escaping to the atmosphere. Furnaces may also be vented to baghouses, electrostatic precipitators, or afterburners.

Other processes which will produce fumes include calcination, sublimation and distillation.

Calcination consists of heating, roasting or smelting to decompose minerals. Calcination is commercially applied in the manufacture of glass and mineral catalysts through the heating of materials such as sand and limestone. It is variously employed to remove moisture or a volatile constituent by such methods as heating limestone to form carbon dioxide gas and calcium oxide, or to reduce minerals by oxidation.

Sublimation is the process in which a solid substance is converted to a gas without a change in composition and without first going through the liquid state. Iodine, carbon dioxide (dry ice) and many metallic and nonmetallic crystals are examples of sublimed materials. Sublimation of these materials may be accomplished by lowering the pressure, raising the temperature, or by changing both temperature and pressure.

Distillation is a cycle of vaporization and condensation in which a liquid is converted to a vapor and condensed to a liquid. Distillation is generally employed to purify a liquid or to segregate components according to relative volatility.

C. Dusts

Dusts are "minute solid particles released in the air by natural forces or by mechanical processes such as crushing, grinding, melting, drilling, demolishing, shoveling, sweeping, sanding, etc."* Dust particles are larger and less concentrated than those in collodial systems such as smoke and fumes and will settle fairly quickly on surfaces.** A dust effluent, however, may also contain many submicroscopic particles.

Dusts are produced from virtually every human activity as well as from the natural environment. Some dusty industries include mineral earth processors such as ceramic and cement manufacturing, calcining, and wood-working and feed and flour industries.

Dust particles generally exceed one micron in diameter and are readily controlled by centrifugal separators, cloth filters and electrostatic precipitators.

D. Mists

Mists are liquid particulates or droplets, about the size of raindrops, such as fog, and are formed by condensation of a vapor, or atomization of a liquid by mechanical spraying. Mist droplets contain contaminant material in solution or suspension. The impregnation and coating of building materials with asphalt, or the manufacture or heating of asphalt at batch plants may produce hazes or fogs containing droplets of liquid asphalt. Paint spraying operations emit liquid particulates containing organic solvents, pigments and other materials. Mists may also be emitted from control devices such as cyclones and scrubbers, using a liquid air cleaning medium. Acid particulates, such as chromic and sulfuric acid produced from chrome plating operations, may also form mists when exhausted to the atmosphere.

It is important to distinguish here between a cloud of liquid aerosols and a mist of liquid droplets especially in relation to liquid contaminants involving sulfur compounds. For example, sulfur trioxide (SO_3) exists at normal temperatures as a liquid. But when exposed to stack temperatures encountered in large oil-burning installations, sulfur trioxide becomes a gas, and, after contact with sufficient moisture in the air, forms as a white-to-blue plume several feet above the stack (detached plume). After further contact with moisture in the air, the sulfur trioxide is transformed to a weak sulfuric acid *mist*. But when the moisture in the mist evaporates, a sulfuric acid aerosol is formed, and if the concentration is sufficient, a visible cloud. The acid mist is more dangerous to health than the aerosol cloud, since the latter can be inhaled and exhaled without effect, whereas the former adheres to respiratory tissue.

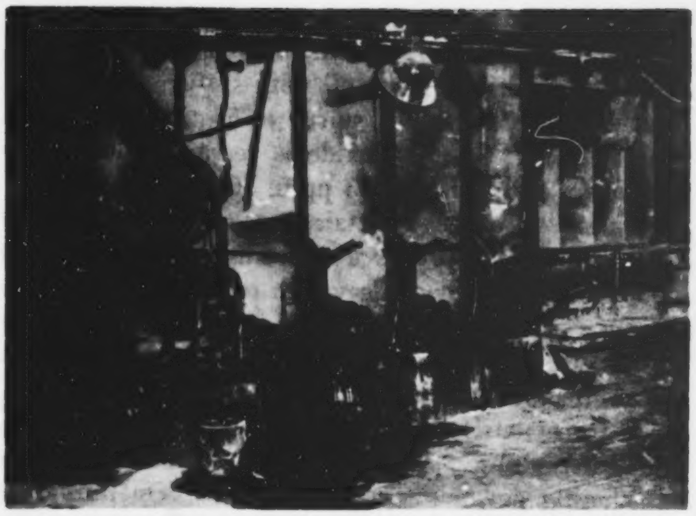

Figure IX - 20. Hot asphalt saturator in roofing plant. Mists may be controlled by wet collectors, mist extractors or electrostatic precipitators.

E. Gases

A gas is a state of aggregated matter or a fluid of freely-moving molecules tending to expand infinitely and to diffuse and mix readily with other gases. As pollutants, gases include a large variety of inorganic and organic gases which may have noxious, malodorous, toxic, or corrosive effects, or which may have an effective smog-producing potential. These include carbon monoxide (CO), ozone (O_3), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), hydrogen sulfide (H_2S), hydrocarbons and their oxidation products, halogens (chlorine, bromine, fluorine, iodine) and their derivatives such as hydrogen fluoride (HF), and the various chlorinated solvents such as those used in industrial degreasing and dry cleaning. Other important toxicants not significant quantitatively in Los Angeles air pollution potentials include ammonia (NH_3), arsine (AsH_3) fluorine (F_2), hydrogen chloride (HCl), phosgene ($COCl_2$) and hydrogen cyanide (HCN).

Two gases which commonly occur in air pollution problems as a result of direct emission to the atmosphere are described below: (For other gases see Chapter 11, *Detecting and Measuring Invisible Emissions.*)

1. Sulfur Dioxide

Sulfur dioxide is a common stack gas produced from the combustion of such fuels as coal, fuel oil and hydrogen sulfide, the burning off of residue on catalyst in oil refining operations, the burning of tail gases from the recovery of sulfur from refinery waste gases, and various other chemical and metallurgical processes. In Los Angeles County the primary source of sulfur dioxide is the burning of fuel oil by refineries and power plants. Crude oil with sulfur content contains from less than 1% sulfur to 5% in some of the heavier fuels. Sulfur dioxide is readily absorbed by vegetation and soil. At 2-3 ppm, SO_2 has a noticeable odor and will damage certain species of vegetation at 1/4 ppm. In the presence of sunlight, sulfur dioxide oxidizes to sulfur trioxide which condenses out in the presence of moisture to form sulfuric acid mist. Although sulfur dioxide is an invisible gas, it oxidizes to sulfur trioxide and emits the detached plume described previously under "mists". This type of plume is commonly observed emitting from the stacks of large oil burning power generating stations. On humid or rainy days the plume will "seed" the atmosphere with sulfuric acid mist and will be abnormally prolonged. Sulfur dioxide gases and sulfuric acid mists are capable of accelerating the corrosion of wires, metals and other materials.

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* Los Angeles County Air Pollution Control District, Rules and Regulations, Rule 2k.

** However, some heavier particles may be so shaped aerodynamically as to "sail" or travel surprising distances from a source, such as metallic substances in metallized paints.

2. Hydrogen Sulfide and Organic Sulfides (Mercaptans)

Both thermal and catalytic cracking processes in oil refining operations tend to convert the sulfur contained in the crude oil into hydrogen sulfide in the heavier materials and mercaptans in the gasoline fractions. When hydrogen sulfide is released to the atmosphere as a gas, it manifests a characteristic rotten egg odor. Mercaptans also exhibit varying types of strong unpleasant odors such as garlic, decayed garbage, skunk or onions from relatively small gas concentrations. Hydrogen sulfide is detectable at .12 ppm and mercaptans from .001 to .041 ppm. H_2S will also discolor some painted surfaces with lead pigments under humid conditions.

F. Vapors

A vapor is the gaseous phase of a substance which at normal temperature and pressure is a liquid or solid.

The most important vapor in the Los Angeles County air pollution problem is that which results from the evaporation of petroleum products, such as the unburned gasoline vapors in automobile exhaust. Gasoline vapors also originate from processes in which volatile products are maintained in storage tanks and from the operation of pumps, compressors and blowers required for moving liquid gas streams.

Another principal source of vapors in Los Angeles County originates from the consumption, marketing and manufacture of paints and other coating products containing organic solvents which are used to dilute or extend surface coatings. These are released to the atmosphere upon application.

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CHAPTER TEN

READING VISIBLE EMISSIONS

Once a plume or effluent is identified as an air contaminant, it must be measured by some standard to determine whether or not a violation of the law has occurred, or it must be evaluated to determine the size or severity of a given air pollution problem. Here the inspector may be required to make evaluations based primarily on direct observation.

First-hand observation, despite its inherent subjectivity, is not so inexact a means of evaluation if it is recalled that air pollution is primarily a nuisance affecting the sense perceptions. Most laws in the history of air pollution control are based on standards which express annoyance to the senses by the use of such qualifying terms as "noxious", "excessive", "repugnant", "injurious". Relative air pollution intensities thus may be rated according to the sense of sight, smell, and, in some cases, touch.

While the sense of smell is extremely unreliable — and of no value at all with odorless contaminants — and the sense of touch, or, rather, physiological response, is only valid in detecting certain types of toxic substances, sight can be employed with a practical degree of accuracy to distinguish between shades or opacities of visible emissions. For this reason, maximum permissible emission standards based on the visual determination of the effluent are widely used around the world.

Compliance with maximum permissible emission standards is determined by visual evaluation of visible emissions, and source testing of emissions which are invisible or near the threshold of vision. This chapter is concerned with the evaluation of visual emissions by the use of the Ringelmann Standard, and, specifically, Section 24242 of the California State Health and Safety Code.

I TECHNIQUES OF VISUAL DETERMINATION

The only practical maximum permissible emission standard which developed for large-scale use in the history of air pollution was one which related to shade or opacity, that is, the darkness or optical density of the plume. Standards which limited emissions according to grain or dust loading alone were obviously impractical due to the difficulty of conducting source tests at all of the sources of air pollution.

The benefits of basing smoke statutes on opacity or density are quite evident, even though equipment and fuel regulations have increasingly assumed precedence in control legislation. Since the visual standard is specific with reference to a cut-off point and time interval, it is simply and directly enforced. All an inspector need do is observe an emission of an opacity or density beyond that allowed for a specific period of time in order to cite a violator for excessive smoke. Also, although the visual standard is limited to estimations of particles of pollution which obscure vision, its application simultaneously tends to reduce grain loading and gaseous contaminants. (As the grain loading in the plume increases, the light transmission decreases exponentially.) In order to comply with the opacity standard, more efficient combustion or equipment operation is necessary. The Ringelmann standard, therefore, is most versatile in accomplishing gross reductions of atmospheric pollutants in a community, and can be applied not only to smoke, but fumes, dusts and mists arising from a variety of problems as well. It is perhaps one of the most comprehensive types of rules adopted.

It should be cautioned, however, that while such benefits can be assumed, they cannot always be precisely predicted or evaluated. No useful correlation exists between the shade or opacity of an effluent with any quantitative measurement of a plume. Some correlation can be made in the study of a specific operation, particularly when grain loadings, operating conditions, and opacities were previously correlated with great care. Determination of opacity and shade of any emission alone, however, gives no specific measurement of the quantities of contaminants being emitted.

A. *Description and Use of the Ringelmann Chart*

The history, description and general use of the Ringelmann Chart is discussed in the Bureau of Mines Information Circular #7718 (August, 1955). Since this document has formed the basis of smoke regulation in many cities, and is used as evidence in many court actions, it is quoted in full here.

> **Summary**
>
> The Ringelmann Smoke Chart fulfills an important need in smoke abatement work and certain problems in the combustion of fuel. A knowledge of its history and method of preparation is, therefore, of interest to many. Since instructions on its use are not shown on the recent edition of the chart, those included in this revision of the previous information circular, by Rudolf Kudlich, now are a necessary complement to the chart. More detail regarding the use of the chart is included than was given in the earlier manuscript.
>
> **Introduction**
>
> The Ringelmann Smoke Chart, giving shades of gray by which the density of columns of smoke rising from stacks may be compared, was developed by a Professor Ringelmann of Paris. Maximilian Ringelmann, born in 1861, was professor of agricultural engineering at l'Institute National Agronomique and Director de la Station d'Essais de Machines in Paris in 1888, and held those positions for many years thereafter.
>
> The chart apparently was introduced into the United States by William Kent in an article published in "Engineering News" of November

11, 1897, with a comment that he had learned of it in a private communication from a Bryan Donkin of London. It was said to have come into somewhat extensive use in Europe by that time. Kent proposed in 1899 that it be accepted as the standard measure of smoke density in the standard code for power plant testing that was being formulated by the American Society of Mechanical Engineers.

The Ringelmann Chart was used by the engineers of the Technologic Branch of the Federal Geological Survey (which later formed the nucleus of the present Bureau of Mines) in their studies of smokeless combustion beginning at St. Louis in 1904, and by 1910 had been recognized officially in the smoke ordinance for Boston passed by the Massachusetts Legislature.

The chart is now used as a device for determining whether emissions of smoke are within limits or standards of permissibility (statutes and ordinances) established and expressed with reference to the chart. It is widely used by law-enforcement or compliance officers in jurisdictions that have adopted standards based upon the chart.

In 1908 copies of the chart were prepared by the Technologic Branch of the Federal Geological Survey for use by its fuel engineers and for public distributions. Upon its organization in 1910, the Bureau of Mines assumed this service together with the other fuel-testing activities of the Technologic Branch.

Additional copies of the chart may be obtained free by applying to the Publications Distribution Section, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

Description and Method of Preparing the Chart

The Ringelmann system is virtually a scheme whereby graduated shades of gray, varying by five equal steps between white and black, may be accurately reproduced by means of a rectangular grill of black lines of definite width and spacing on a white background. The rule given by Professor Ringelmann by which the charts may be reproduced is as follows:

Card 0 — All white.
Card 1 — Black lines 1 mm. thick, 10 mm. apart, leaving white spaces 9 mm. square.
Card 2 — Lines 2.3 mm. thick, spaces 7.7 mm. square.
Card 3 — Lines 3.7 mm. thick, spaces 6.3 mm. square.
Card 4 — Lines 5.5 mm. thick, spaces 4.5 mm. square.
Card 5 — All black.

The chart, as distributed by the Bureau of Mines, provides the shades of Cards 1, 2, 3, and 4 on a single sheet, which are known as Ringelmann No. 1, 2, 3, and 4, respectively.

Use of Chart

To learn to use the chart, it is supported on a level with the eye, at such a distance from the observer that the lines on the chart merge into shades of gray, and as nearly as possible in line with the stack. The observer glances from the smoke, as it issues from the stack, to the chart and notes the number of the chart most nearly corresponding with the shade of the smoke, then records this number with the time of observation. A clear stack is recorded as No. 0, and 100 per cent black smoke as No. 5.

To determine average smoke emission over a relatively long period of time, such as an hour, observations are usually repeated at one-fourth or one-half minute intervals. The readings are then reduced to the total equivalent of No. 1 smoke as a standard. No. 1 smoke being considered as 20 per cent dense, the percentage "density" of the smoke for the entire period of observation is obtained by the formula:

$$\frac{\text{Equivalent units of No. 1 smoke X 0.20}}{\text{Number of observations}} = \text{percentage smoke density}$$

Figure X-1 shows a convenient form for recording and computing the percentage of smoke density. This procedure is often used on acceptance tests of fuel-burning equipment.

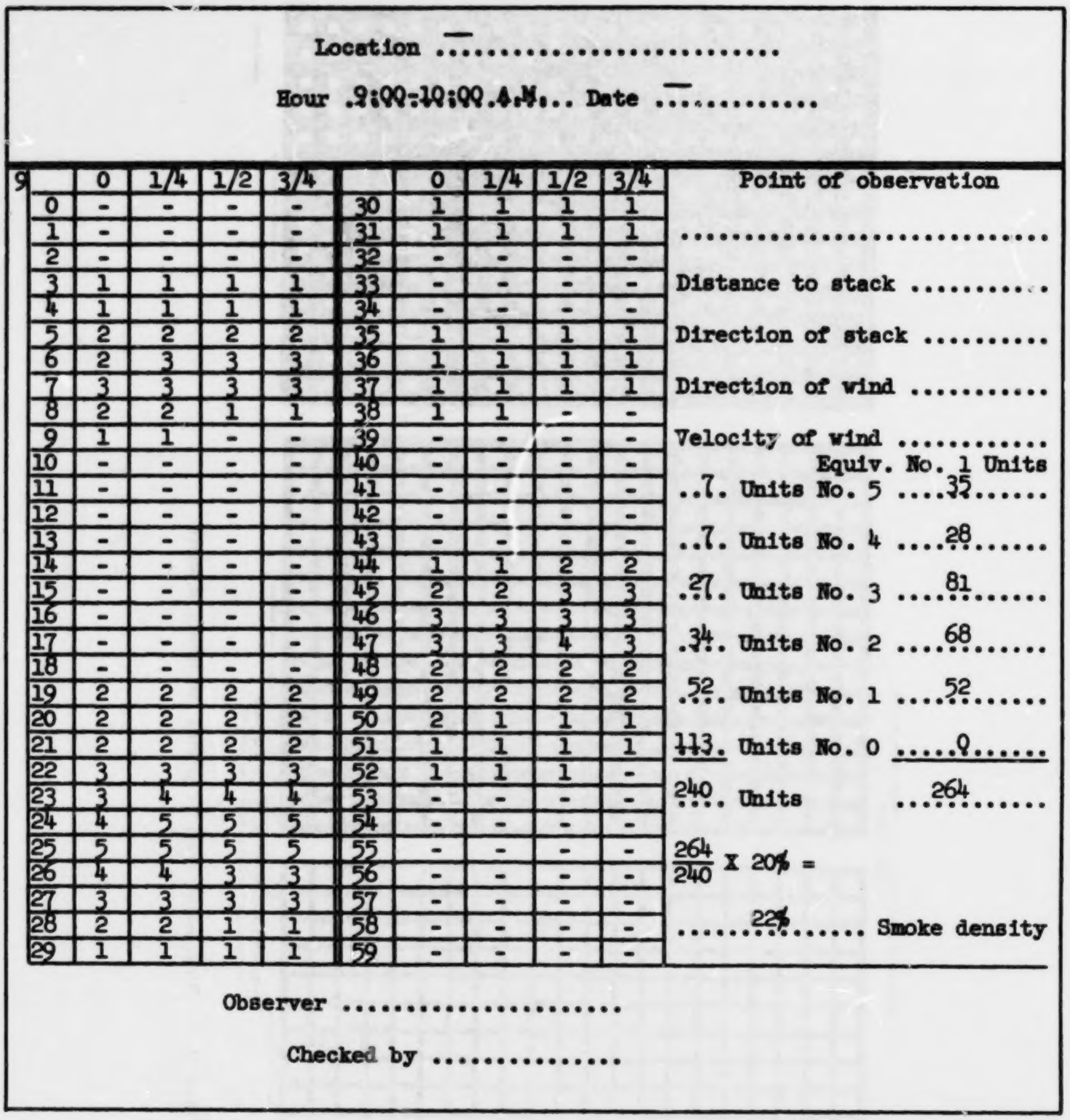
The timing and extent of observations made for the purpose of determining compliance with a local smoke abatement ordinance depend upon the wording and smoke limitations of the ordinance.

There are two general methods of using the chart. One is for the observer to make actual reference to it, as previously described, while judging the smoke shade. The other method is based on the fact that, with proper experience, it is unnecessary for an observer to continue to refer to the chart. By repeated reference to the chart, during a suitable training period, the shades of the Ringelmann scale become fixed in the observer's memory. Hence, the chart is used by most cities only for training and examination of smoke inspectors, before certification that they are proficient in judging smoke shade on the Ringelmann scale without referring to the chart. Since smoke-shade observations by inspectors, thus trained and certified, are easily made and are accepted as evidence in courts, this latter method of using the chart is preferred by most authorities.

B. *Smoke Measuring Methods*

Although virtually all of the control agencies have employed the Ringelmann Chart as a means of defining smoke standards, the methods by which smoke densities and opacities are determined by enforcement officers in the field vary. Some agencies use special measuring devices, whereas other agencies train their personnel to sight-read the effluent emissions within a prescribed degree of accuracy without making direct reference to the Ringelmann Chart. Some of the devices used are described as follows:

1. *Smoke Tintometer*: This instrument, developed prior to 1912, used tinted glasses graduated to the Ringelmann scale for visual comparison with the smoke. It contains two apertures, one for observing the smoke and one for viewing the clear sky through the opening or through one of the tinted glasses. This instrument is probably not significantly more effective than a trained sight-reader.



Location —..........................

Hour .9:00-10:00 A.M... Date —............

9	0	1/4	1/2	3/4		0	1/4	1/2	3/4
0	-	-	-	-	30	1	1	1	1
1	-	-	-	-	31	1	1	1	1
2	-	-	-	-	32	-	-	-	-
3	1	1	1	1	33	-	-	-	-
4	1	1	1	1	34	-	-	-	-
5	2	2	2	2	35	1	1	1	1
6	2	3	3	3	36	1	1	1	1
7	3	3	3	3	37	1	1	1	1
8	2	2	1	1	38	1	1	-	-
9	1	1	-	-	39	-	-	-	-
10	-	-	-	-	40	-	-	-	-
11	-	-	-	-	41	-	-	-	-
12	-	-	-	-	42	-	-	-	-
13	-	-	-	-	43	-	-	-	-
14	-	-	-	-	44	1	1	2	2
15	-	-	-	-	45	2	2	3	3
16	-	-	-	-	46	3	3	3	3
17	-	-	-	-	47	3	3	4	3
18	-	-	-	-	48	2	2	2	2
19	2	2	2	2	49	2	2	2	2
20	2	2	2	2	50	2	1	1	1
21	2	2	2	2	51	1	1	1	1
22	3	3	3	3	52	1	1	1	-
23	3	4	4	4	53	-	-	-	-
24	4	5	5	5	54	-	-	-	-
25	5	5	5	5	55	-	-	-	-
26	4	4	3	3	56	-	-	-	-
27	3	3	3	3	57	-	-	-	-
28	2	2	1	1	58	-	-	-	-
29	1	1	1	1	59	-	-	-	-

Point of observation

....

Distance to stack ....

Direction of stack ....

Direction of wind ....

Velocity of wind ....

		Equiv. No. 1 Units
..7.	Units No. 5	....35......
..7.	Units No. 4	....28......
.27.	Units No. 3	....81......
.34.	Units No. 2	....68......
.52.	Units No. 1	....52......
113.	Units No. 0	.....0......
240.	Units	....264.....

$\frac{264}{240}$ X 20% =

.......22%...... Smoke density

Observer ....

Checked by ....

Int. - Bu. of Mines, Pgh., Pa. 6866

Figure X-1. Ringelmann Chart reading scheme suggested by the Bureau of Mines.

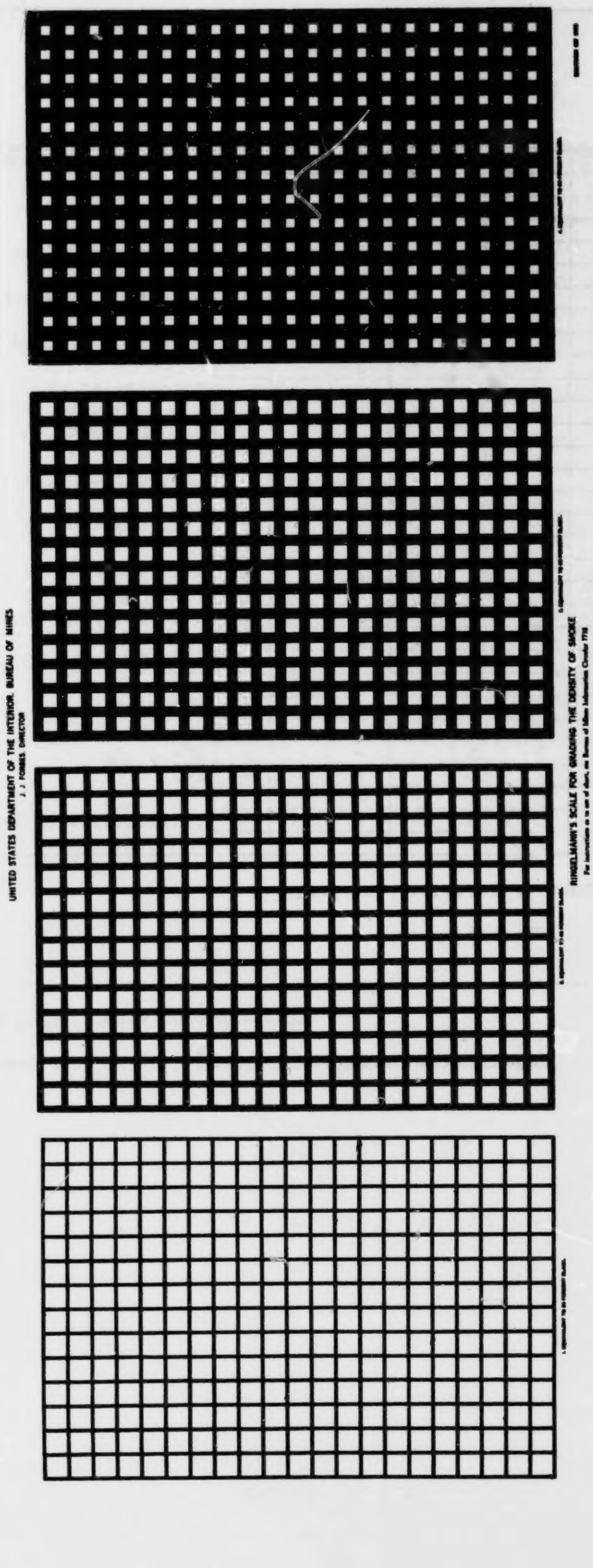

UNITED STATES DEPARTMENT OF THE INTERIOR. BUREAU OF MINES
J. J. FORBES, DIRECTOR
RINGELMANN'S SCALE FOR GRADING THE DENSITY OF SMOKE

Figure X-2. Ringelmann's scale for grading the density of smoke.

2. *Umbrascope*: This is a tube using tinted glass segments which can be adjusted to cover one-half of the field of view. The smoke can then be compared visually with the darkness of the glass. Its main disadvantage is its small range.

3. *Smokescope*: This instrument uses a film disc of two shades graduated to #2 and #3 on the Ringelmann Scale. One aperture is used for viewing the smoke and one for viewing the film reference disc against the background. Its disadvantage is that the quantity of light falling on the reference disc may be influenced by objects nearly in line with the smoke. Judgment and skill are required in its use.

4. *Photoelectric Cells*: Photoelectric smoke metering equipment measures variations in the intensity of a beam of light passing through the effluent in the stack, thus directly measuring opacity or optical density. Because the equipment is permanently built into the stacks at the sources of air pollution, these devices are not portable for transporting by field inspectors to the stacks. However, they may be required either by permit condition or law to be constructed, and are of particular importance in training air pollution inspectors to sight-read effluents.

   In these devices, a constant light source is used to illuminate a standard photoelectric cell, both of which are diametrically opposed across the stack. The light source must pass through any smoke which will rise in the stack before falling on the cell. Thus the cell will produce a current of electricity which is directly proportional to the amount of light falling upon the cell, i.e., the lumens of light falling upon the cell are directly related to the microamperes of current transmitted by the cell to the smoke measuring meter.

   The metering devices vary in construction — some use a potentiometer, a closed circuit relay, or a direct reading microammeter. Regardless of the type of smoke meter used, or the method of calibration, the amount of current generated by the cell will be either directly or inversely proportional to the amount of light falling on the cell, and will exhibit a straight curve function which may be considered to be linear.

5. *Smoke Comparison Charts*: Several smoke comparison charts were reported in the A.S.M.E. (1936) Power Code. One of these was a circular chart with radial lines of various widths. The operator spins the chart on an object inverted through a hole in the center of the chart. The apparent shades of gray on the spinning chart are then compared with the smoke. Shades of gray have also been produced on photographic film for smoke comparison charts. Another device consists of black lines photographed on celluloid film which is seen partly by transmitted light and partly by reflected light.

6. *Sight Reading*: In Los Angeles County, the direct sight reading method of determining violations of visible emissions without the use of the Ringelmann Chart at the scene of the violation was required for several reasons. First, Section 24242 limits emissions of air contaminants according to opacity, as well as Ringelmann Smoke Density. It was found that the general principles of visual determinations apply to both opacity of colored plumes as well as smoke density. Smoke reading devices are limited to gray smoke. Secondly, it was found that devices were cumbersome and were generally not significantly more accurate in establishing opacity violations. Inspectors can be trained to read within ½ Ringelmann or 10% opacity. Thirdly, the methods by which the inspector is trained and the methods by which he reads visible emissions have been validated by the courts.

   The accuracy and validity of the sight reading method, without immediate reference to the Ringelmann Chart, are determined by intensive initial training, periodic refresher courses and proficiency testing. The initial and continuous refresher training an inspector receives is of prime importance in establishing his expertness.

   The training conducted consists of two important phases: (1) Training in the principles of smoke and opacity readings, and (2) proficiency training in the reading of smoke.

C. *Principles of Smoke and Opacity Reading**

The Bureau of Mines pamphlet, quoted previously, describes the various cards of the chart. The terms "density" and "opacity", however, as used in the literature are only inferentially defined. The semantics of these has been the subject of much controversy and have been confused by defense attorneys attempting to invalidate the entire smoke reading procedure.

The definitions of these terms are, however, rather simple, as they are limited by the law and the nature of the Ringelmann Chart.

1. *"Smoke Density"*: "Density" means the "quantity of anything per unit of volume or area", as defined by Webster's Dictionary. An examination of the Ringelmann Chart discloses the obvious fact that the shades of gray smoke are reproduced

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* Based in part on reference 3.

according to the ratio of the area occupied by the black grid lines to the total area of each card, and are expressed as the per cent of each card blackened. Since the black grid lines represent opaque areas, and the white spaces the area through which light is transmitted, it is implicit in the design of the Ringelmann Chart that "smoke density" can only be defined as a measure of degree of opacity. This definition does not imply any relationship with the definition which might be made in terms of "weight per unit volume".

To determine the per cent densities of each Ringelmann Card we need simply subtract the square of the distance across a white space from the distance between the black lines as measured from the center of each line. Since the first card of the chart contains black lines 1 mm. thick, 10 mm. apart, leaving white spaces 9 mm. square, the per cent of the area which is black is calculated as follows:

$(10^2) - (9^2) =$
$100 - 81 =$ 19.0% of total area covered by the black (opaque) grid lines

By similar calculation, Cards 2, 3, and 4 are found to be 40.71%, 60.31% and 79.75% black. Since the accuracy demanded of the chart for all purposes in which it is to be used will not be 1% or less, these panels may be considered as perfect 20% increments. That is, the density of Card 0 is 0 per cent; Card 1, 20 per cent gray; Card 2, 40 per cent gray; Card 3, 60 per cent gray; Card 4, 80 per cent gray; Card 5, 100 per cent black.

Thus the Ringelmann Smoke Densities on the chart may, by the optical phenomenon of the blending of black lines to form varying shades of gray when the chart is placed at a distance from the observer, be measured by equivalent percentages of opacity. This is true because the black grid lines are seen only as the obscured area, and the white spaces are seen as the background or the area through which the light is transmitted. Smoke density is therefore nothing more than degree of opacity.

2. *"Opacity"*: The term "opacity" means the degree to which transmitted light is obscured. The degree of opacity is usually rated directly in percentage of perfect opacity, 0 per cent opacity being equivalent to perfect transparency, and 100% opacity being perfectly opaque. In air pollution work opacity is actually judged by the degree to which an observer's view is obscured. That is, the expert reader makes his judgment of opacity on the basis of the amount of background, sky or light that he *cannot* actually see through the emission. This manner of observing and recording the opacities of visible emissions is clearly implicit in the law. For instance, Section 24242 of the State Health and Safety Code prohibits smoke of periods totaling more than three minutes in any one hour . . .
   (a) . . . as dark or darker in shade as that designated as No. 2 on the Ringelmann Chart . . .
   (b) Of such opacity as to *obscure an observer's view* (emphasis supplied—ed.) to a degree equal to or greater than does smoke . . . (described in "a", above)

   It is obvious that the Ringelmann Chart and the Opacity method are measured in direct equivalents in that they both measure the same thing. The determination of density is actually the determination of opacity. The difference is that the Ringelmann Chart is a recognized standard applied only to shades of gray smoke. The opacity system is applied only to the shades of all other colored emissions.

3. *Other Principles*: *In reading smoke it is not necessary for a trained observer to actually use the Ringelmann Chart in his smoke measurement.* The thought process is the same without the chart for all color emissions. The U. S. Bureau of Mines pamphlet states that "observers with proper experience find it unnecessary to continue to refer to the chart". The Superior Court of Los Angeles County, in a recent appeal, ruled that "in proving a violation, a witness may testify although he did not have a Ringelmann Chart actually in the field with him at the time he made his observations. One does not have to have a color chart in his hands to recognize a red flower, a blue sky, or a black bird".* Thus, through training and repeated examination, enforcement personnel are made proficient in applying standard Ringelmann reference readings to field determination of both the shade and density or opacity of any visible emission, without regard to its basic color — whether black, white, yellow, or any other color.

   The A.S.M.E. Power Test Code(1) *states that smoke may be read with Ringelmann Charts from several blocks away with a clear atmosphere and clear sky.* Thus the distance from the smoke is limited primarily by conditions of visibility and positive identification of the source. The 1955 revision of the Bureau of Mines Circular does not specify any required distance from the smoke.

   The A.S.M.E. recommends placing the chart so that the same light falls on the chart as on the smoke. The observer should not be looking toward the sun while the face of the chart is shaded. About the same amount of light should be reflected from the white portion of the chart as comes from the background of the smoke. Opaque smoke charts are seen wholly by reflected light while light colored smoke is seen mainly by transmitted light. Thus, with a properly placed chart, 60% of the light reflected from a No. 2 Ringelmann Chart is equal to 60% of the light transmitted through a No. 2 black smoke plume.

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* *People vs. Plywood Mfr's of California* (*CRA* 3284-5), *Shell Oil Company* (*CRA*-3286), *Union Oil Company* (*CRA* 3303-06), *Southern California Edison Company* (*CRA* 3327), *November* 21, 1955. Memorandum Opinion of Superior Court, County of Los Angeles.

1. Smoke Reading School*

With these principles clearly and legally established, it is now possible to train inspectors to become expert smoke readers. An expert smoke reader can be defined as one who can distinguish smoke densities within a margin of error of ½ Ringelmann or ten per cent opacity in a significant number of readings during both the hours of light and darkness and from any given view of the emission.

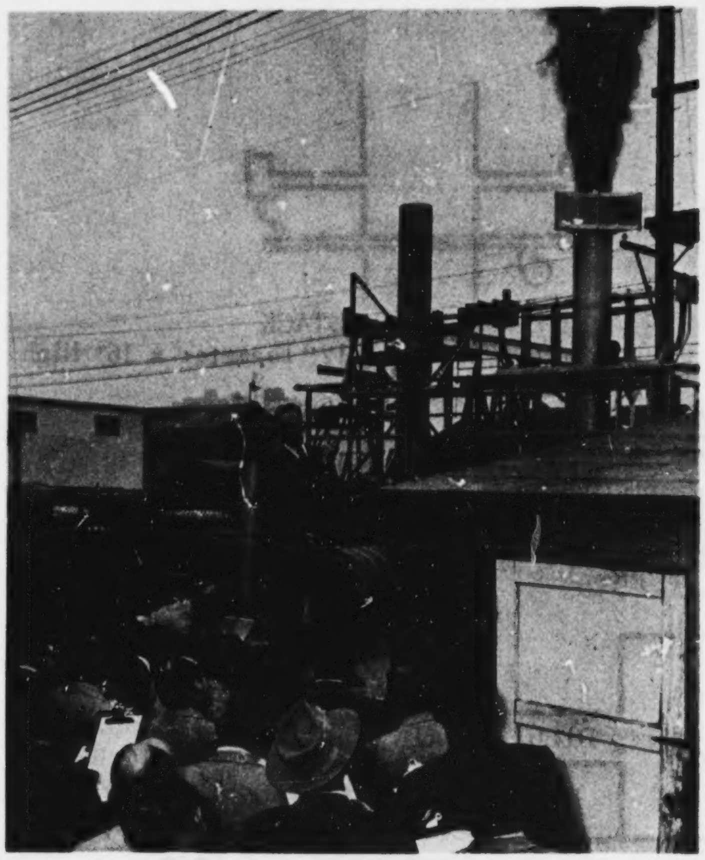

Figure X-3. A.P.C.D. Smoke School. Inspectors are trained to make visual determinations of Ringelmann Smoke Density by use of a black smoke generator equipped with a photoelectric cell. The stack on the left serves a white smoke generator used to train inspectors in reading smoke opacities. To qualify as an expert, the inspector must not deviate more than plus or minus 10% from the smoke measuring meter for any 50 readings.

During the early period of smoke reading instruction at the A.P.C.D., technical problems were encountered in reading and sustaining a desired smoke density or opacity with the training equipment then available. As a result, a specially-designed black smoke generating system was placed in operation in 1953, and a comparable white smoke generating system one year later. (See Figures X-4 and X-5.) A specially designed metering system was installed to replace the conventional density recorder since in the latter device the several stages of amplification were subject to malfunctions which influenced the accuracy of meter readings.

a. Smoke Generating Equipment

In the design of smoke generating equipment, attention was given to a means of regulating air fuel ratios, to preventing horizontal distortion of the smoke plume through the action of wind, and to accurate determination of the actual smoke density or opacity being observed by trainees.

The systems now utilized consist of two smoke generating units, each with a vertical stack and a density or opacity detection system.

(1) *Black Smoke System*: In this unit, the combustion chamber consists of a 40-cubic foot rectangular steel box, lined with six inches of refractory fire clay.

The oil burner is a modified mechanical pressure atomizing type, with the combustion air fan set to operate continuously at full capacity. Various degrees of incomplete combustion of the fuel are obtained by altering air fuel ratios through adjustment of the fuel flow rate. This adjustment is secured through manual operation of a needle valve located in the fuel supply line, between the pressure pump and the spray nozzles. Combustion products pass from the chamber through a horizontal duct and cooling chamber into a vertical stack where they pass through the opacity detection system and are vented into the atmosphere. A force draft fan, discharging approximately 300 cubic feet of dilution air per minute into the base of the stack, deters wind-caused horizontal distortion of the smoke plume. The cooling chamber prevents secondary combustion from occurring at the base of the stack as the combustion products are diluted with air.

(2) *White Smoke System*: In this system, the specific opacity desired is obtained by controlling the rate at which a distillate type of oil is sprayed into a vaporizing chamber where it is diluted with air. Upon leaving this chamber, the generated smoke enters a vertical stack where it passes through the opacity detection system before venting to the atmosphere. At times, it is necessary for the operator to adjust both the oil pressure on the spray nozzle and the heating chamber temperatures in order to sustain a specific opacity.

(3) *Opacity and Density Detection Systems*: The opacity and density detection systems comprise a

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* Based on reference 2.

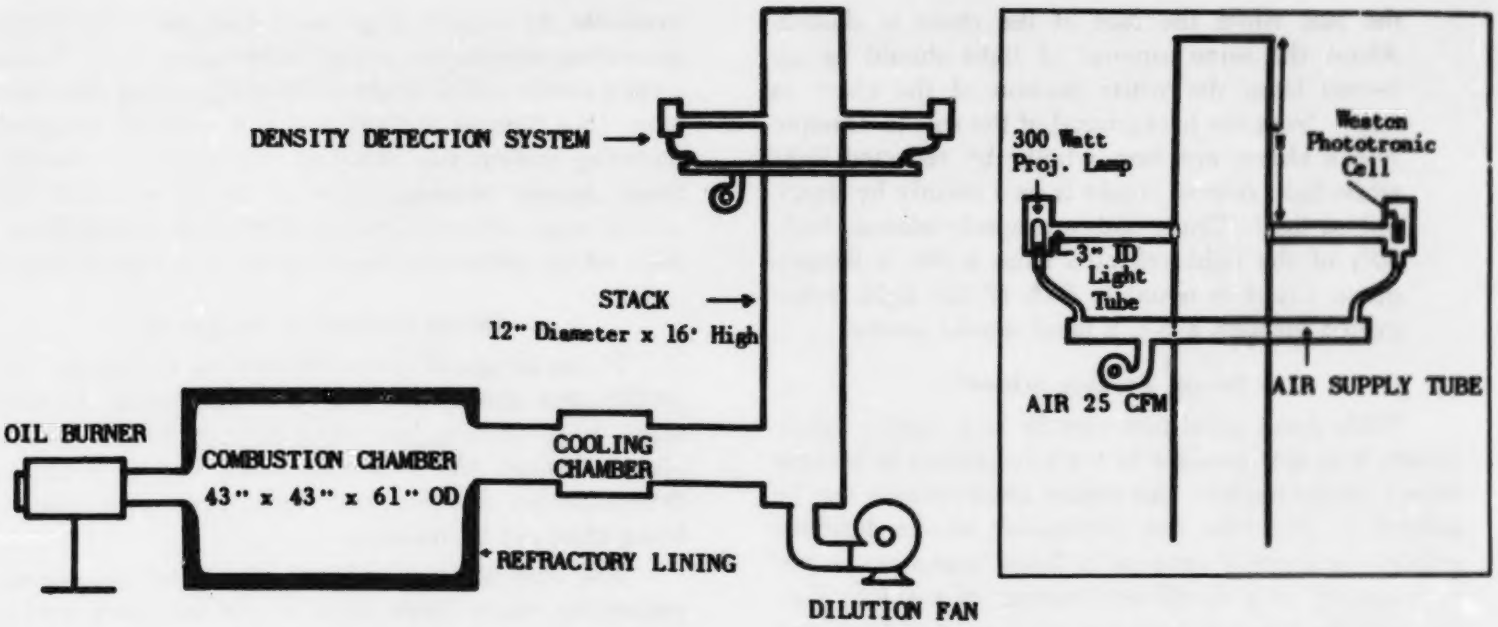


Figure X-4. Design of gray smoke generator used by the A.P.C.D.

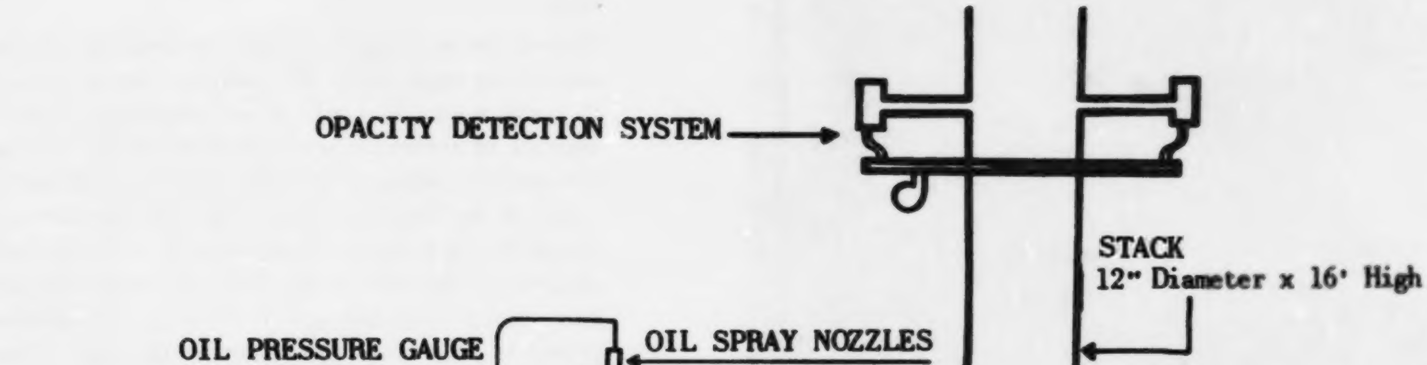


Figure X-5. Design of white smoke generator used by the A.P.C.D.

light source, a photoelectric cell and a milliammeter.

A photoelectric cell and a light source are positioned at opposite ends of a light tube protruding horizontally from each side of the smoke stack. Upon receiving light energy passed through the tube, the photoelectric cell generates an electrical current which deflects the pointer of a milliammeter. The face of the meter has been modified so as to indicate, not the amperage reaching the meter, but rather the per cent of opacity or density of the measured plume. Normally, a milliammeter reading 100 would be registering free passage of light from the source of the cell. It therefore was necessary to reverse the scale of the meter so that 100 would indicate that no light energy was reaching the cell and that 0 would indicate free passage of light. When the operator adjusts the foot-candle output of the light source to cause a full scale deflection in the milliammeter, an opacity of zero is read. Conversely, if the light is turned out, no light energy reaches the cell and the milliammeter, therefore, reads one hundred, or 100% opacity.

The detection system has been calibrated to permit accurate reading of smoke opacity and density in terms of the Ringelmann standard. This has been accomplished by inserting photographic plates of known opacities and densities between the light source and the photoelectric cell. Through this method milliammeter deflections of 20, 40, 60 and 80 are produced.

b. Training Methods

The training objective of the "smoke-reading school" is a level of individual inspector proficiency which permits field determination of smoke opacity or density within a margin of error of ½ Ringelmann, or 10 per cent opacity. The past experience of the District indicates an optimum average deviation of 7 to 8 per cent with an acceptable and attainable group deviation of not more than 10 per cent. Since any emission equal to or greater than No. 2 Ringelmann constitutes a violation in Los Angeles County, it can be proven that a violation has occurred when an inspector, trained in the District smoke school determines that an emission equals or exceeds No. 2½ Ringelmann.

During the instructional sessions, trainees are positioned approximately fifty feet from the smoke generator stacks.

As the training run begins, inspectors observe the emission and, in the case of a black or gray emission, compare it with a Ringelmann Chart posted on the generator stack. Whenever the generator operator sounds a bell, the trainees individually record their reading of opacity or density, and then are advised by the Instructor as to the actual opacity or density, as determined by the detection system.

Training runs are conducted under a variety of conditions simulating actual field situations under varying conditions of light and darkness, and from many different possible views of the plume in respect to the inspector's position and the light source. Background color and varying lighting conditions may be critical to accurate opacity determination of white or other colored emissions, and these varying factors, therefore, are introduced during the training runs.

During the initial smoke-reading training given a new inspector, approximately one hour is devoted to the training run, and, during refresher sessions, approximately thirty minutes. In total, each inspector receives twenty-four hours of smoke-reading instruction during his initial entry-training, and annually, thereafter, receives six refresher training sessions, each of four hours' duration.

c. Proficiency Testing

Testing of individual inspector proficiency is conducted both as a diagnostic device to determine the need for additional training and as a means of assuring a level of expertise that will fully meet the requirements of the District's field operation program and the possible test of a court action.

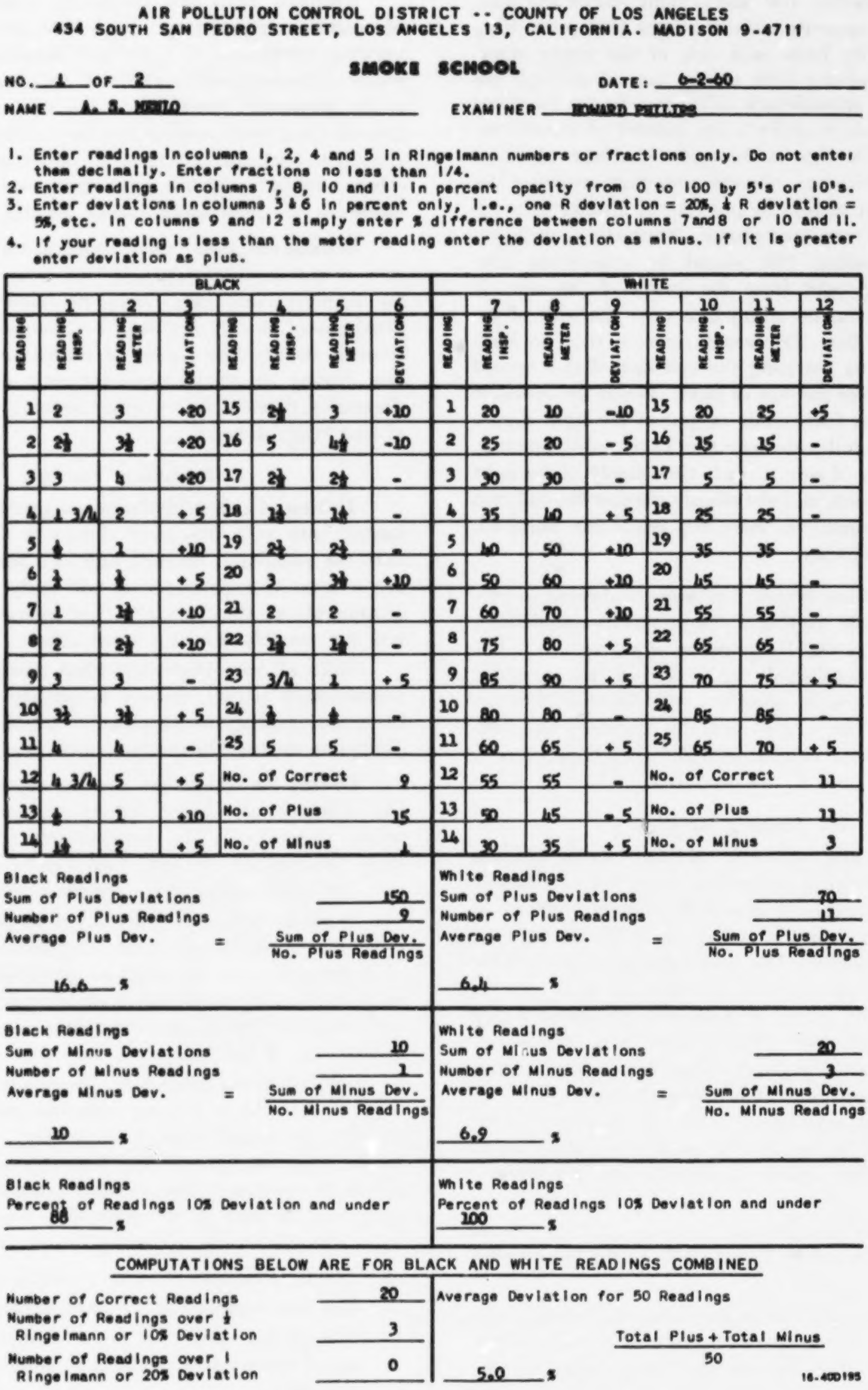
Since all new inspectors must serve a six-month probationary period, failure to qualify fully during the training program may lead to termination of employment during the probationary period.

During the test, inspectors are required to record fifty readings of effluent density or opacity from the smoke generators. The determinations are recorded on a "Proficiency Record" (See Figure X - 7) whenever the generator-operator sounds a bell.

Since air pollution emissions of 40 per cent opacity or density are illegal in Los Angeles County, testing of inspectors is concentrated on determination of the inspector's ability to discriminate between emissions in the range of 30 to 50 per cent opacity or density, with testing also of the highs and the lows.

Scoring of the inspector's "Proficiency Record" is accomplished by recording opposite the inspector's reading, the actual opacity or density as determined by the detection system. The trainee's deviation from the meter reading is then indicated in an adjacent column, and for each set of twenty-five readings indicated on the record the following computation is made:

1. The total number of correct readings.
2. The total number of plus and minus readings.
3. The average plus and minus deviations for each set of twenty-five readings as well as for the entire fifty.
4. The percentage of readings deviating less than ½ Ringelmann from the actual opacity or density.



AIR POLLUTION CONTROL DISTRICT -- COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA. MADISON 9-4711

SMOKE SCHOOL

NO. 1 OF 2

DATE: 6-2-60

NAME A. S. MENLO

EXAMINER HOWARD PHILLIPS

1. Enter readings in columns 1, 2, 4 and 5 in Ringelmann numbers or fractions only. Do not enter them decimally. Enter fractions no less than 1/4.
2. Enter readings in columns 7, 8, 10 and 11 in percent opacity from 0 to 100 by 5's or 10's.
3. Enter deviations in columns 3 & 6 in percent only, i.e., one R deviation = 20%, ¼ R deviation = 5%, etc. In columns 9 and 12 simply enter % difference between columns 7 and 8 or 10 and 11.
4. If your reading is less than the meter reading enter the deviation as minus. If it is greater enter deviation as plus.

BLACK								WHITE							
	1	2	3		4	5	6		7	8	9		10	11	12
READING	READING INSP.	READING METER	DEVIATION	READING	READING INSP.	READING METER	DEVIATION	READING	READING INSP.	READING METER	DEVIATION	READING	READING INSP.	READING METER	DEVIATION
1	2	3	+20	15	2½	3	+10	1	20	10	-10	15	20	25	+5
2	2½	3½	+20	16	5	4½	-10	2	25	20	- 5	16	15	15	-
3	3	4	+20	17	2½	2½	-	3	30	30	-	17	5	5	-
4	1 3/4	2	+ 5	18	1½	1½	-	4	35	40	+ 5	18	25	25	-
5	½	1	+10	19	2½	2½	-	5	40	50	+10	19	35	35	-
6	½	½	+ 5	20	3	3½	+10	6	50	60	+10	20	45	45	-
7	1	1½	+10	21	2	2	-	7	60	70	+10	21	55	55	-
8	2	2½	+10	22	1½	1½	-	8	75	80	+ 5	22	65	65	-
9	3	3	-	23	3/4	1	+ 5	9	85	90	+ 5	23	70	75	+ 5
10	3½	3½	+ 5	24	½	½	-	10	80	80	-	24	85	85	-
11	4	4	-	25	5	5	-	11	60	65	+ 5	25	65	70	+ 5
12	4 3/4	5	+ 5	No. of Correct			9	12	55	55	-	No. of Correct			11
13	½	1	+10	No. of Plus			15	13	50	45	- 5	No. of Plus			11
14	1½	2	+ 5	No. of Minus			1	14	30	35	+ 5	No. of Minus			3

Black Readings
Sum of Plus Deviations 150
Number of Plus Readings 9
Average Plus Dev. = Sum of Plus Dev. / No. Plus Readings
16.6 %

White Readings
Sum of Plus Deviations 70
Number of Plus Readings 11
Average Plus Dev. = Sum of Plus Dev. / No. Plus Readings
6.4 %

Black Readings
Sum of Minus Deviations 10
Number of Minus Readings 1
Average Minus Dev. = Sum of Minus Dev. / No. Minus Readings
10 %

White Readings
Sum of Minus Deviations 20
Number of Minus Readings 3
Average Minus Dev. = Sum of Minus Dev. / No. Minus Readings
6.9 %

Black Readings
Percent of Readings 10% Deviation and under
88 %

White Readings
Percent of Readings 10% Deviation and under
100 %

COMPUTATIONS BELOW ARE FOR BLACK AND WHITE READINGS COMBINED

Number of Correct Readings 20
Number of Readings over ½ Ringelmann or 10% Deviation 3
Number of Readings over 1 Ringelmann or 20% Deviation 0

Average Deviation for 50 Readings
Total Plus + Total Minus / 50
5.0 %

16-40D195

Figure X - 6. Smoke School Proficiency examination sheet.

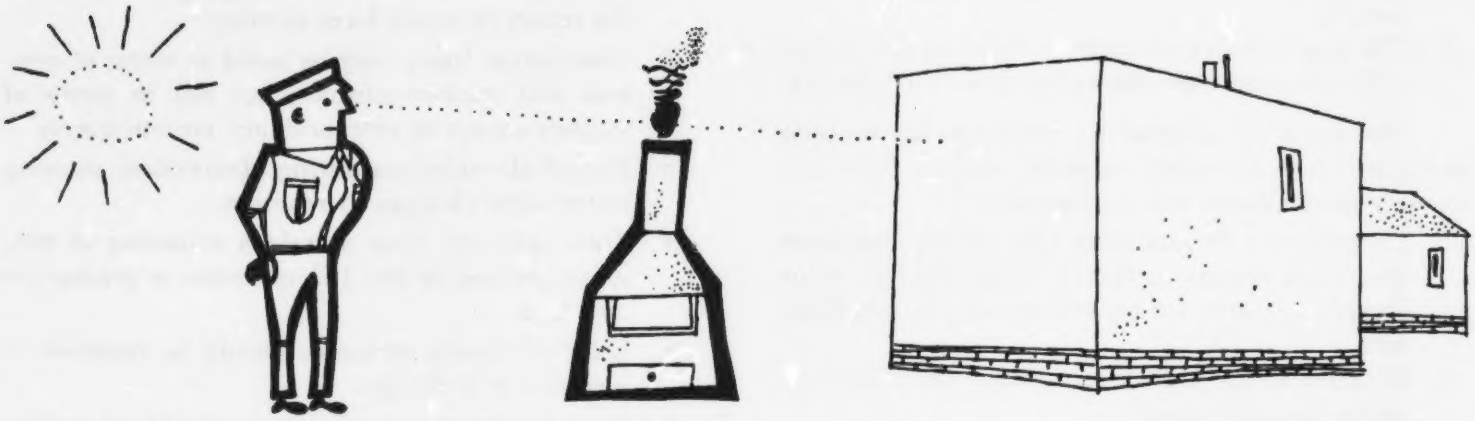


Figure X - 7. Light source should emanate from the rear of observer during daylight hours (reflected light).

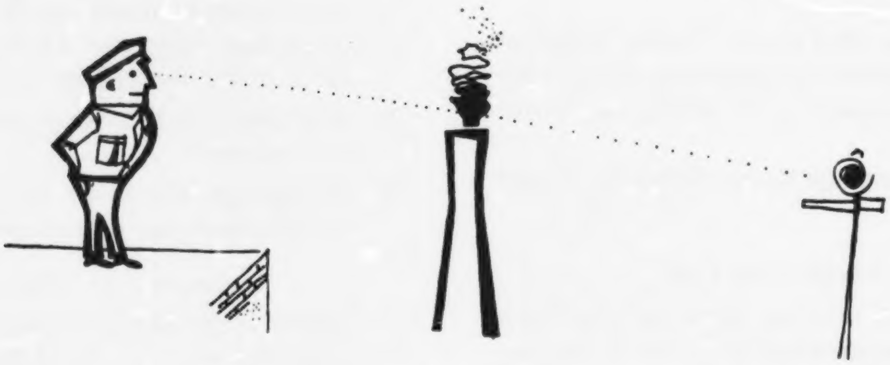


Figure X - 8. During darkness, the light source should emanate from behind the plume, opposite the observer (transmitted light).

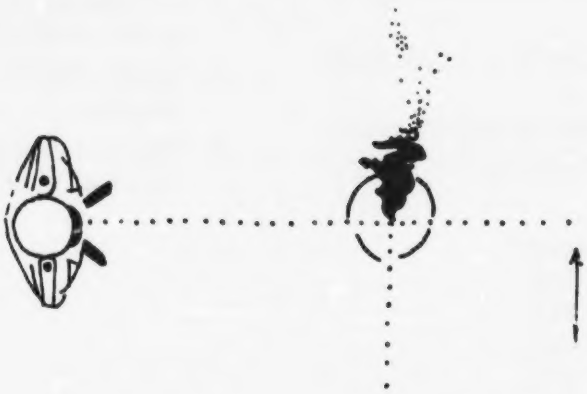


Figure X - 9. Readings should be made at right angles to wind direction and from any distance necessary to obtain a clear view of stack and background.

5. The total number of readings deviating more than ½ Ringelmann from the actual opacity or density.
6. The total number of readings deviating more than 1 Ringelmann from the actual opacity or density.

The inspector successfully completes his training and qualifies as an expert in smoke reading if his proficiency record meets two requirements:

1. He must not deviate more than 10 per cent from the actual opacity or density determination of the detection system for an average of fifty readings, and
2. He must demonstrate a consistency and reliability in his determinations.

Even though a trainee achieves an average within the allowable 10 per cent deviation, he does not qualify if any reading deviates 20 per cent or more from the actual, or his readings are inconsistent with one another.

An analysis of the Proficiency Record indicates whether or not the inspector was guessing, whether his determinations are consistent, and whether he reads high or low.

Weakness on any of these factors dictates the need for further training.

2. Reading Smoke in the Field

On the basis of the training given in the smoke school, and the accepted methods by which visual determinations are made, the following general rules apply to sight-reading in the field.

a. Reading Air Contaminants

1. Black smoke is read in densities and recorded in Ringelmann numbers.
2. All other colored emissions are read in opacities and recorded in percentages.
3. All opacity readings are related to corresponding densities on the Ringelmann Chart in the following manner:

RINGELMANN	OPACITY
#1	20%
#2	40%
#2½	50%
#3	60%
#3½	70%
#4	80%
#4½	90%
#5	100%

4. Light source should be from rear of observer during daylight hours.
5. Light source should be behind plume during hours of darkness (transmitted light).
6. Readings should be made at right angles to wind direction, and from any distance necessary to obtain a clear view of stack and background.

b. Recording Air Contaminants

1. Readings are recorded in the appropriate space on the report or notice form as taken.
2. Observation times may be noted in terms of minutes and quarter-minutes, but not in terms of seconds except in extraordinary circumstances.
3. Record all emissions during observation, showing consecutive changes in readings.
4. *Total only the time in which emissions of 40% or greater and/or No. 2 Ringelmann or greater are observed.*
5. Color of visible emissions should be recorded as seen and as it changes.
6. It is advisable to record all or a significant portion of the periods of excessive smoke observed during the inspection.
7. A Violation Notice cannot be issued unless the source emitted excessive smoke for more than three minutes in any one hour and preferably for more than 4 minutes. Continuing emission should be recorded for at least six minutes of violation.
8. Any one hour means any period of sixty consecutive minutes.
9. Photograph should be taken before or after but not during visual determinations.

c. Smoke from Moving Sources

1. Smoke from tailpipes and exhausts of vehicles is generally read in the same way that it is read from stationary sources. The observer following or pursuing a vehicle, however, should avoid reading directly into the plume, if possible. Line of observation should intersect the smoke trail at as wide an angle as possible. Error of reading smoke in this fashion should be compensated for.
2. Smoke should be read at its point of maximum density.
3. Stop watch should be used to record accumulated violation time.

REFERENCES

1. American Society of Mechanical Engineers, *Power Test Codes, Determinations*, 1936.
2. Griswold, S. S., Parmelee, W. H., McEwen, L. H., *Training of Air Pollution Inspectors*, presented before 51st Annual Meeting, Air Pollution Control Association, Philadelphia, Pennsylvania, May 28, 1958.
3. Hocker, Arthur J., *Opacity Reading Principles*, report to the Director of Enforcement, 6-28-56.
4. Kudlich, Rudolf, *Ringelmann Smoke Chart*, United States Department of the Interior, Bureau of Mines Information Circular #7718, revised by L. R. Burdick, August 1955.

CHAPTER ELEVEN

DETECTING AND MEASURING INVISIBLE CONTAMINANTS

"Invisible" contaminants are any contaminants the field inspector cannot identify or measure by means of direct and unaided observation, but whose presence is indirectly or inferentially determined either by flow analysis or by physiological reaction. These include contaminants which are transparent gases, particulates below the threshold of vision in both size and quantity, any visible plume containing such contaminants, or any plume, usually below No. 2 Ringelmann or 40% opacity, which may require quantitative measurement.

Essentially, the problem of the inspector is to determine the *identity* (the chemical element or compounds involved, such as sulfur dioxide, carbon monoxide, etc.) and the *concentration* (actual numerical values in units of measurement: p.p.m., per cent volume, grains, pounds, tons, micrograms, etc.). Obviously such determinations normally fall within the science of testing and measurement, involving a high degree of specialization and skill, and are not truly within the scope of the field inspector's duties. Nevertheless, there are various situations in which the field inspector must depend upon these sciences and upon such knowledge of air pollution chemistry as will provide the necessary clues and evidence he will require for enforcement and other field purposes. These are as follows:

1. Stationary Source Testing. Although not a skilled member of a test team, the inspector will require an understanding of stationary source testing in order to make intelligent requests for testing of stacks suspected of violating various contaminant rules. He must also be prepared to recommend testing methods and to suggest the conditions under which testing should be performed.
2. Toxicity and Physiological Reaction. The inspector should be prepared to make an intelligent estimate of the concentrations of certain contaminants on the basis of physiological response, particularly where toxic contaminants and potential hazards may be involved.
3. Sampling of Effluents and Fuels; Fuel and Equipment Regulation. In the enforcement of fuel and equipment rules the inspector may be required to sample for laboratory analysis, gaseous, liquid or solid fuels or materials, including gasoline.
4. On-the-Spot Testing. The inspector may conduct some limited field testing himself with portable equipment in order to establish the existence of a nuisance or to determine hazardous concentrations of contaminants. This type of testing is usually made of the outdoor atmosphere, but may also be applied to some stack effluents.
5. Interpretation of Test Results. The inspector should be able to interpret the results of test data in order to properly determine the course of enforcement action, and to prepare documentary evidence.
6. Reading Air Monitoring Devices. As a general air pollution technician, the inspector may be required to take readings from air monitoring equipment located at air sampling stations.

I STATIONARY SOURCE TESTING

Source testing is crucial to any program which attempts to control a major and diversified air pollution problem. It is not only a means whereby evidence may be gathered to determine compliance with maximum permissible emission regulations based on grain and dust loadings, or volumetric concentrations, but it is used as a basis for granting or denying permits and establishing emission factors for computing air pollution potentials.

Stationary source testing refers to the techniques employed to sample, identify and measure contaminant concentrations in a stack effluent. The samples collected may be analyzed in the laboratory for such properties as particle size, weight, soiling characteristics, reactivity, etc. Because of a host of variables encountered in testing and sampling, source testing must be carefully planned.

It is necessary to schedule the categories of data required in advance and to select the proper equipment. Of great importance is the number of samples and the various sampling methods required to produce statistically significant results. The object here is to take as many samples as will approximate actual stack conditions.

Sampling methods are divided sharply between those which test for gases and those which test for particulates and dusts.

The methods applied to gases may be grouped according to the particular characteristics of the gases and vapors, such as solubility and vapor pressure. For instance, water soluble gases can be collected with water, those which are not water soluble may be absorbed by highly reactive reagents or special solvents, whereas those which react slowly may require special treatment for collection.

Sampling methods applied to dusts and particulates may also be affected by the solubility of the material, or by their organic or inorganic nature. Perhaps the most important factors in the sampling of particulates are the size, volume and the velocity at which they are emitted.

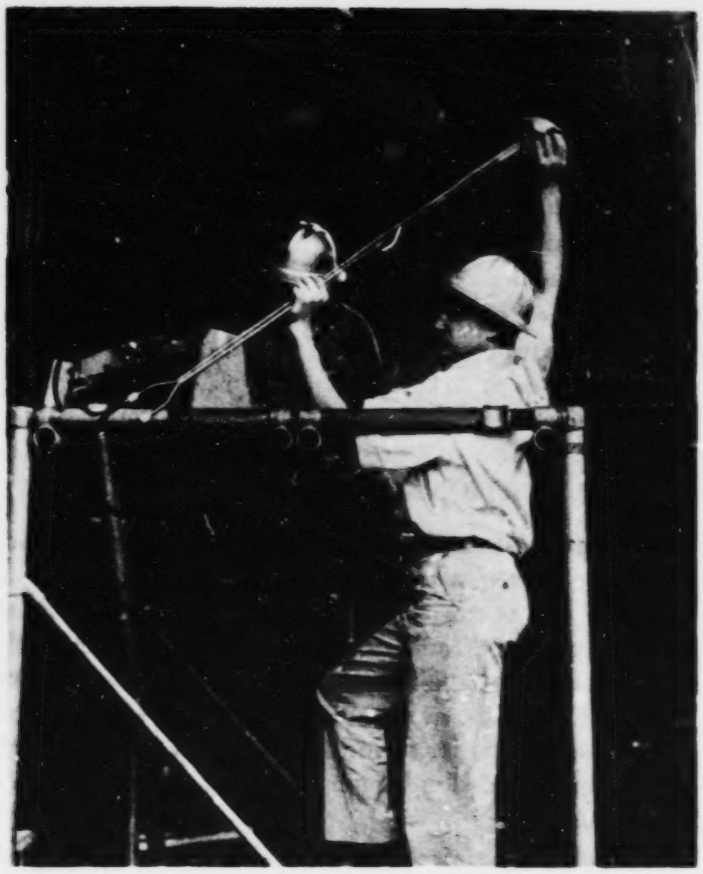


Figure XI - 1. Members of an A.P.C.D. testing crew insert Pitot tube in stack breeching to measure exhaust velocity on a differential gauge. This source test was conducted to sample oxides of nitrogen from a steel smelting operation.

A. Determining Velocity and Temperature of Effluent

Where a quantitative determination is to be made (gravimetric or volumetric), it is necessary that measurements be made with maximum precision of the flow rate, and the volume and temperature of the gas stream carrying the particulates.

The volume of gas in a stack or duct system is the product of the average flow rate of that gas and the area of the cross section of the stack or duct. The flow rate is determined by means of a Pitot tube and differential pressure gauge. An anemometer can be used when the flow rates are less than 10 feet per second. Venturi meters and orifice disc meters may be used to measure high velocities or pressures in ducts with small diameters.

To assure accuracy, the measurement of velocity is taken at a number of representative points in the stack or duct cross-section. This area is divided into a number of equal areas, the centers of which comprise the sampling points. Where the flow rate is determined to be uniform, sampling at one point is sufficient. Where flow rates fluctuate greatly at any of the points, many samples are taken, and when the flow varies uniformly at the representative points, a few samples are sufficient at each point.

The actual temperature and pressure of the stack gas are corrected to standard conditions of 60°F. and 14.7 pounds per square inch absolute, as required by Rule 3.

B. Probe, Sample Line and Sample Train

The sampling apparatus for stack gases as shown in Figures XI-1 and XI-4 consists of three main sections: (1) the sample probe, (2) the trap or traps intended for the collection of specific contaminants, and (3) the vacuum pump with flow meter and flow regulation devices.

In order to obtain representative concentrations of particulates, samples must be collected under conditions of isokinetic flow(1). This means that the sample probe must be adapted to the specific stack by utilizing the appropriate nozzle size, and so situated and adjusted as to assure that the rate and direction of the gas flow is the same in the sampler as in the stack. The required rate of flow through the meter for a given nozzle diameter is obtained from the following relation (2):

$$M = \frac{\pi\ d^2}{4\times144} \times V \times 60 \times \frac{Tm}{Ts} = 0.33\ \frac{Tm}{Ts}\ V\ d^2$$

where

M = Meter rate, cubic feet per minte
Tm = Temperature in meter, degrees F. absolute
Ts = Temperature in stack, degrees F. absolute
V = Velocity of stack gases, feet per second
d = Diameter of sampling nozzle, inches

The sample probe, usually ¼" to ½" in diameter, is connected to the collection equipment and is inserted at sample points in the stack either at the stack outlet or the breeching close to the flame end point in combustion equipment, depending on the purpose and requirements of the test. (See Figures XI-2 and XIII-5.) The probe is long enough to traverse the diameters of most ducts and stacks. Sample probes are usually made of stainless steel, glass or quartz to withstand reaction with sampling materials, high temperatures, and corrosion.

Many air pollution inspectors in specialized enforcement components are equipped with probes and

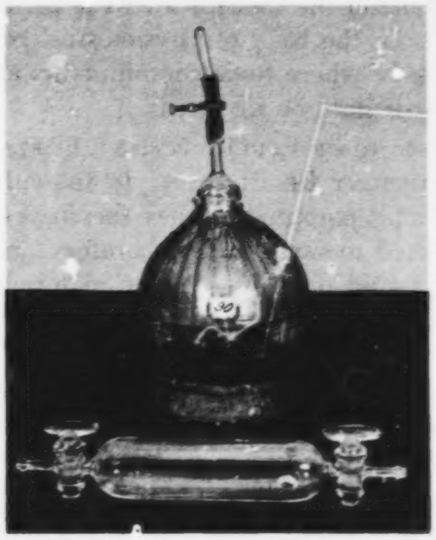


Figure XI - 2. Sample bottle and evacuated flask.

simple collection bottles and other equipment which enable them to collect and to take samples to the laboratory for analysis. The use of such equipment, however, is greatly limited to sampling of stationary facilities at permanent industrial locations such as refineries and power plants and other locations where construction of sampling facilities is mandatory. Where only identification of effluent constituents are required at these locations, accurate quantitative measurements are unnecessary.

The inspector looks for a sampling point which is not too close to any bend in the ductwork or stack so as to avoid eddies and turbulence of gas flows. Since sampling may be conducted under a slight negative pressure, 1 to ½" water, the sample line is flushed by steam injection or compressed air, employing facilities at the source of air pollution. When the line is flushed, the sample is drawn through the sample feed line by means of an impinger and aspirator, or syringe, displacement or other suction producing methods, into a sample bottle with shutoff valves (Figure XI-2).

For determining compliance with maximum permissible regulations a sampling train arranged for collection of specific contaminants follows the probe (see Figure XI - 4). In most enforcement tests all that is really required is a quantitative measurement of grain or dust loading and gas volume for Rules 52, 53 and 54. The standards stipulated by the rules are primarily gravimetric, or volumetric in the case of Rule 53a, "Specific Contaminants". These tests generally involve specialized skills and elaborate equipment and are conducted by a special component of the Engineering Division, rather than the Enforcement Division. When tests become necessary in any enforcement action they are requested by the inspector.

We shall deal here with the particular types of traps or sampling devices used first in the collection of particulates, then gases. Following this discussion, a survey of the methods employed by the A.P.C.D. in sampling for specific contaminants shall be presented.

C. *Particulate Sampling Devices**

The methods used in sampling particulates are in themselves similar in principle to the various types of dust control equipment employed by industry. The principles involved are based on sedimentation or settling, inertial or centrifugal action, filtration, impinging and impacting, electrostatic and thermal precipitation. The sampling devices, however, must possess a very high collection efficiency for all particle sizes collected.

1. *Sedimentation and Settling Devices.* These are generally settling chambers, fallout jars, Petri dishes, trays and gum paper stands used for collecting particulates which may settle out of the atmosphere. The settling chamber can be used for obtaining grab samples of representative volumes of air, from which a rough quantitative analysis can be performed. Because the collection of particulates by these methods for quantitative analysis is subject to many inaccuracies, they are generally limited to estimating dustfall trends in an area. Gum paper stands, or stands coated with petroleum jelly are particularly useful to inspectors in tracking down unidentified sources of particulates involved in public nuisances.
2. *Inertial or Centrifugal Collection Equipment.* These are midget cyclone collectors used for gravimetric determinations of large particles such as fly ash, usually above 1 micron in diameter. For particles over 10 microns cyclone collectors are almost 100% efficient. Inertial collection equipment is simple in design, temperature resistant, and has low pressure drop. The samples collected may be readily removed. (See Figures XI-7 and XI - 8.)
3. *Filtration.* Equipment used in this method consists of a suction type blower system which draws the air through a specially selected filter medium. The filter medium may be soluble or insoluble. Soluble filters, in particular — such as the millepore filter — may be dissolved to recover the particles. The filtration method is particularly useful in collecting almost unlimited quantities of particulates which can be analyzed for weight, particle size and composition. In overcoming the difficulty of separating the particulate from the filter medium, a soluble filter medium can be used. Samplers may be of the high volume, tape or molecular types. Filtration is suitable for measurements of mass quantity, soiling properties, chemical analysis, counting and sizing, and determining radioactivity.
4. *Impingement.* Impingers provide for the separation of the particulates by means of sudden changes in direction of the gas stream. The wet impinger is useful in collecting fine particles. In the dry type impinger, the particulates impinge and adhere to special surfaces. The latter is limited to relatively larger particles. The impinger is suitable for counting and sizing and for detailed chemical analysis. A well known impinger is the Greenburg-Smith or "midget impinger", which is small, efficient and relatively inexpensive.
5. *Cascade Impactors.* This consists of a number of impingement stages through which the velocities of the gas stream systematically vary, thus collecting and sorting particles in several size ranges. The collection surfaces are small collodion screens on microscopic slides for study under the microscope. The cascade impactor is almost 100% efficient and will collect particulates ranging from .7 micron to 50 microns.

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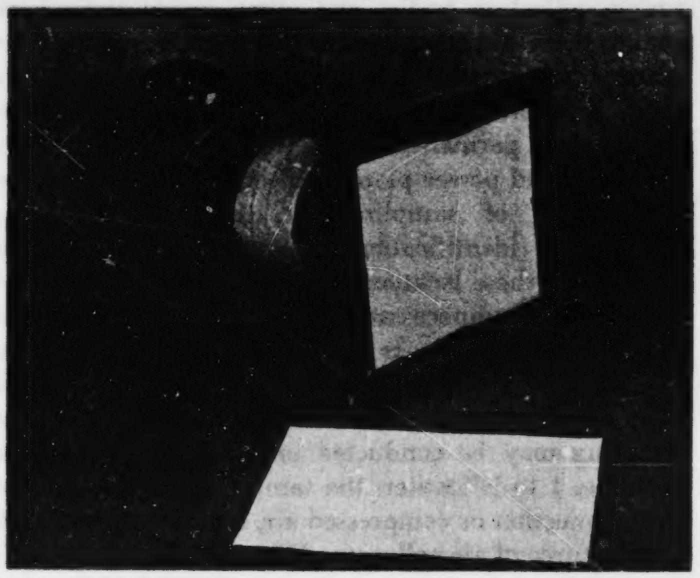
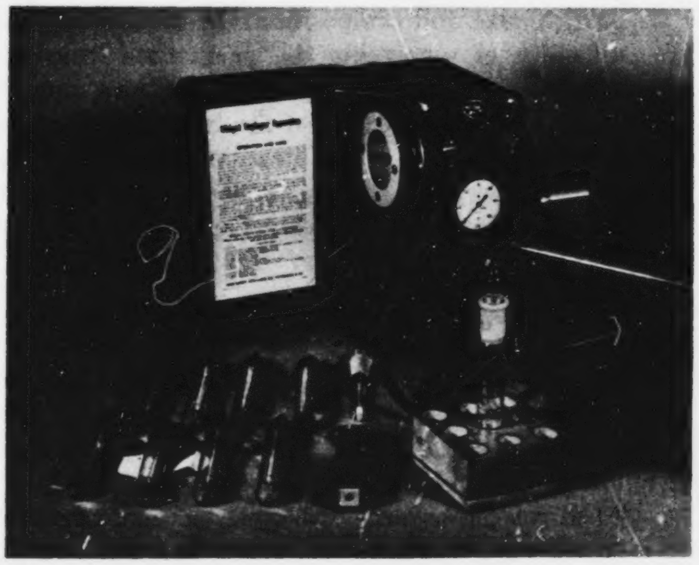
*Based in part on reference 3.

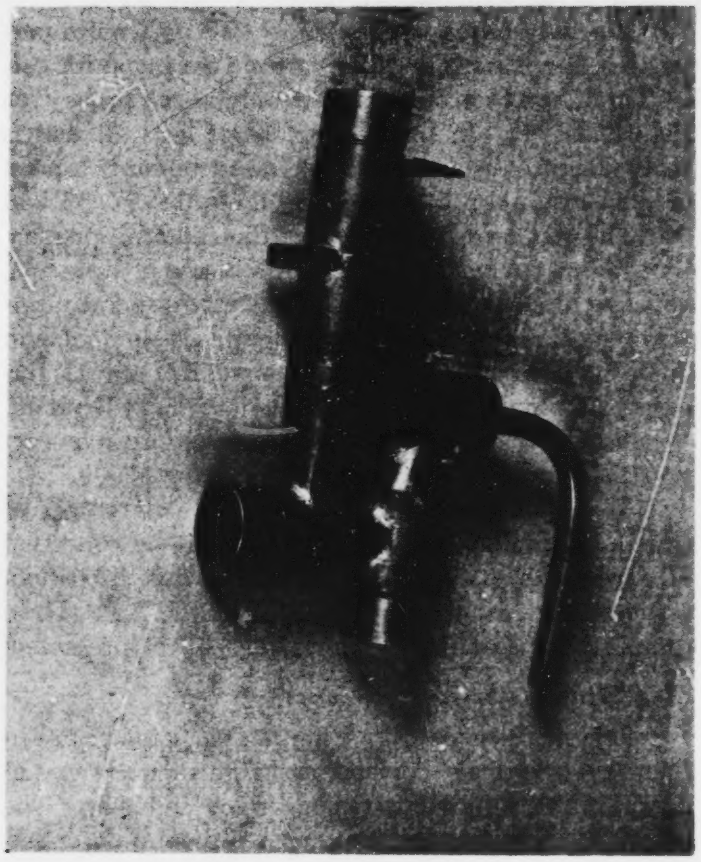
Electrostatic dust and fume sampler.



"Staplex" sampler and filter.



Midget impinger apparatus.



Cascade impactor.

Figure XI - 3. Portable contaminant sampling devices.

6. *Electrostatic Sampling Devices.* Electrostatic sampling devices are highly efficient and can be used for studying the physical characteristics of airborne particulates ranging below 1 micron in size. These function on the principle of ionization of particles by means of a platinum electrode. The particles are collected on a removable electrode of opposite charge.
7. *Thermal Precipitators.* These devices are based on the principle that particulates carried in a slow moving gas stream between hot and cold surfaces will settle out on the cooler surface, due to the heat transfer or convection between the surfaces. Thermal precipitators are designed to collect the particles on a coated grid for examination under the electron microscope. Although these devices will collect sub-micron particles, they do not satisfactorily collect particles over a wide-size range.

D. *Gas Sampling Devices*

Since the properties of gases and vapors radically differ from those of particulate matter, different test methods apply. Gases do not conglomerate or settle out, so they cannot be adequately collected by means of filtration, precipitation or impaction. Gases, however, may be absorbed into reactive solutions, dissolved in solvents, collected by adsorption to an active surface area of a solid, condensed out by freezeout methods (ice bath) or may be captured bodily by means of dry evacuated flasks.

The sampling of gases consists primarily of separating the gas being sampled from other gaseous media, such as air. In sampling, it may be necessary to utilize a filter to capture the particulates which may adsorb some of the gases and interfere with accurate gas sampling.

The volumes of individual gases at the same pressure in any mixture are additive. Each gas in a mixture has its own pressure. The total pressure of the gas mixture will thus consist of the sum of the individual pressures. The term "part per million" (ppm) is a measurement based on the proportion of gas volumes. The determination of part per million is equivalent to per cent of volume, and can be calculated by simple arithmetical proportion. Ten thousand parts per million is equivalent to 1% of gas volume. Sulfur dioxide at 0.2 per cent volume is equivalent to 2000 parts per million of air.

In sampling for gaseous contaminants, temperature and pressure conditions are of the utmost importance, and must be accurately recorded. A weight or a Standard Temperature Pressure volume analysis should always be converted back to the temperature and pressure conditions existing when the sample volume was first measured.

Gas sampling techniques are adapted either to the sampling of specific gaseous compounds, or to determinations of gross gaseous contaminant concentrations. The specific methods are generally used for testing inorganic gases or reactive organic gases, and in almost every case involve an absorption method by bubbling the gas through a reactive liquid agent or by exposing the contaminated air to impregnated papers and granules for colorimetric reactions.

For sampling mixtures of contaminated gases, the freezeout, adsorption and grab sample techniques may be used. For concentrations of specific gases greater than 1 ppm, squeeze-bulb methods may be used (see "On-the-Spot Testing").

E. *Sampling for Specific Contaminants*

An example of source testing for combustion contaminants, including particulates and gases, follows. This source testing procedure is conducted to determine compliance with Rule 53a and b, sulfur compounds and combustion contaminants. Sampling methods for ammonia, organic acids, hydrocarbons, aldehydes, and oxides of nitrogen are also described*.

1. The Sampling Train

The sampling train consists of a sampling nozzle, three impingers (4, 5, 6) in series in an ice bath, a weighed paper thimble, dry gas meter and pump, all connected as shown in Figure XI-4. A glass tube bent to point into the gas flow may serve as the sampling nozzle and is used when the stack temperature does not exceed 900°F. The sampling rate for this train may range from one-half to one cubic foot per minute.

The first two impingers in the train each contain 100 ml. of distilled water and the third impinger is dry with a thermometer attached to the stem.

During the sampling, the Pitot tube and thermocouple are inserted into the stack at the reference point. The following readings are taken at least once every five minutes for the duration of the test:

1. Meter reading. (Also taken at start and end of run.)
2. Meter vacuum.
3. Gas temperature at meter.
4. Temperature in third impinger.
5. Pitot tube draft gauge.
6. Stack temperature.

The impingers serve to cool the stack gas sample, to collect particulate matter, and to condense moisture from the gases before they pass through the paper thimble. The thimble collects any particulate matter which may pass through the impingers.

The duration of the sampling is normally one hour, but in some cases the operating conditions encountered may require a longer or shorter time for sampling.

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* Quoted directly, in part, from Kanter, Lunche and Fudurich, reference 2.

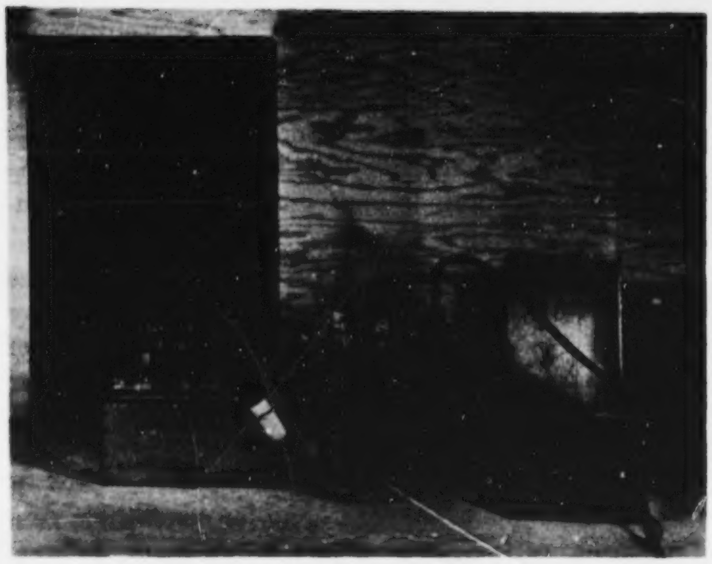

Figure XI - 4. Prescribed sampling train for combustion contaminants. The first two impingers following the glass sampling tube contain water, but the third one is dry. A paper thimble, meter and pump complete the sampling train.

2. Sampling for Carbon Dioxide

Under the provisions of Rule 53b, the concentration of combustion contaminants must be calculated to 12 per cent carbon dioxide. This gives a standard basis for all types of combustion operations, and insures against circumvention of the Rule by dilution. Thus on all tests for combustion contaminants, it is necessary to determine the average carbon dioxide concentration for the period of sampling.

An integrated gas sample for Orsat analysis is collected by withdrawing gases continuously from the stack at a constant rate by a liquid displacement method. As shown in Figure XI-5, a five-liter bottle filled with a saturated sodium sulfate solution, acidified with sulfuric acid, is used as the collecting gas holder. As the solution siphons out, the gas sample is drawn into the bottle. The rate of siphoning is adjusted so that a gas sample of about four liters is obtained during the course of the test. The sample is drawn from the stack at the same cross section used for collecting the combustion contaminants.

3. Measuring the Combustion Contaminant Sample

At the end of the sampling period the sampling train is disconnected, and all the collection apparatus is stoppered and returned to the laboratory for analysis.

The paper thimble is dried in a constant temperature oven for 30 minutes at 105°C. and allowed to condition in the balance room before being weighed. A weighed control thimble is treated similarly, so that a correction may be applied to the sampling thimble for any change of weight which may occur because of humidity changes in the balance room temperature.

The solution in the impingers is volumetrically measured. An increase in volume occurs because of condensation of moisture from the stack gases. This must be taken into account when calculating the sample volume.

The contents of the impingers and connecting tubing are carefully washed into a beaker and slowly evaporated to a volume of 20 to 30 ml. This is transferred quantitatively to a weighed 50 ml. beaker, and evaporated to dryness at 105°F. in an oven. The beaker is cooled in a desiccator and weighed.

The total weight of combustion contaminants is the sum of the weights of material collected in the impingers and the thimble.

The volume of flue gases sampled is the difference in initial and final meter readings plus the volume calculated from the water condensed in the impingers. This moisture volume is obtained as follows:

$$W = \frac{C}{453.6} \times \frac{379}{18} \times \frac{Tm}{520} \times \frac{29.92}{(Pa\text{-}Pm)} = 0.00267\ C\ \frac{Tm}{Pa\text{-}Pm}$$

where

W = Vapor volume of condensed moisture at meter conditions, cubic feet
C = Volume of condensed water, ml.
Tm = Temperature in meter, degrees F. absolute
Pa = Atmospheric pressure, inches of mercury
Pm = Meter vacuum, inches of mercury

The combustion contaminants are reported as grains per standard cubic foot, calculated to 12 per cent carbon dioxide.

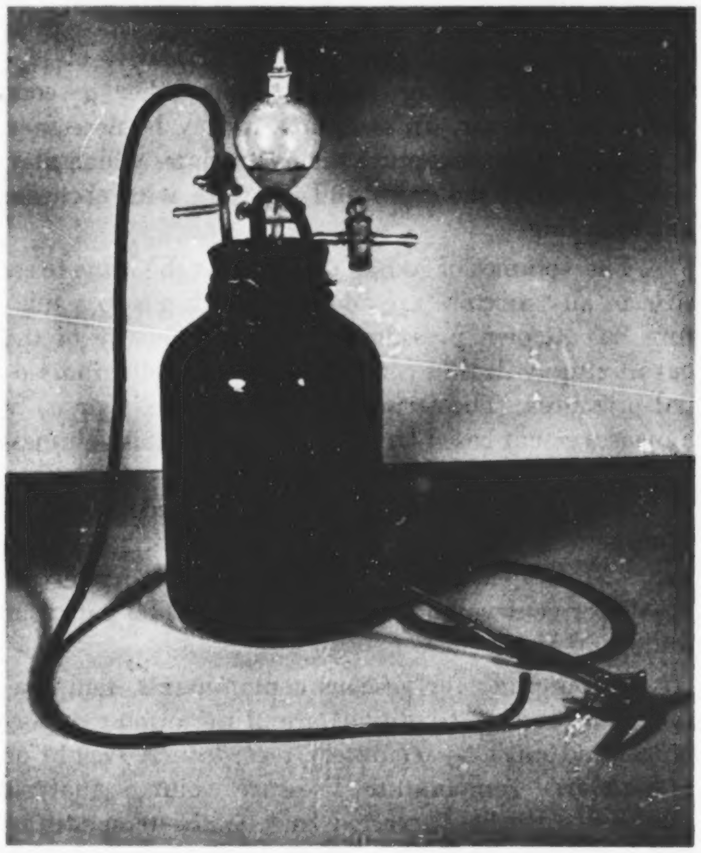

Figure XI-5. Bottle for collecting sample for CO_2 determination. Contains acidified sodium sulfate solution. Gas is drawn in during siphoning out of solution. After gas sample is collected, solution in funnel is allowed to flow down to maintain a pressure in the bottle slightly above atmospheric.

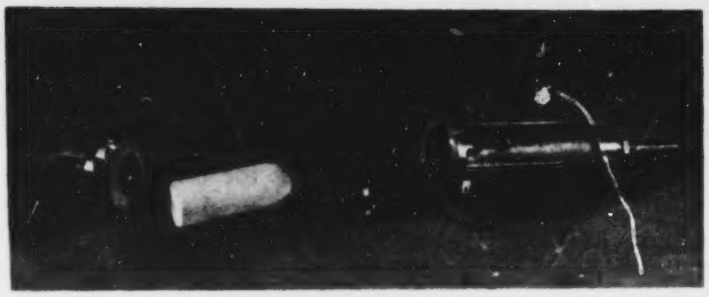

Figure XI - 6. Alundum thimble and holder. From left, sampling nozzle cap, with heat resistant gasket, alundum thimble with glass wood plug, spring and holder, thimble housing.

4. Alternate Sampling Trains for Particulate Matter

In many cases, tests are run to obtain information about the particulate matter being emitted from the combustion process when the question of compliance with existing rules is not involved. In addition to grain loadings, it may be desirable to make particle size determinations, microscopic studies, or chemical analyses. In these cases, other sampling trains more suitable to the desired purposes may be used.

In one train, an alundum thimble is placed before the impingers so that the particulate matter is collected in a dry state (Figures XI-6 and XI-7). Very fine particulate matter will usually pass through the alundum thimble and be collected in the impingers. The weights of the material collected are obtained in a manner similar to that described for the prescribed sample train.

A miniature glass cyclone has been used in front of the thimble (Figure XI-8) on a number of tests to separate out the particulate matter above five microns.

5. Sulfur Dioxide and Sulfur Trioxide

The sampling train for sulfur dioxide and sulfur trioxide consists of a paper thimble maintained just above the dew point of the stack gases followed by three series-connected impingers immersed in an ice bath, a dry gas meter and a pump. The thimble acts as a collector for the sulfuric acid aerosol formed from the sulfur trioxide. The first two impingers contain 100 ml. each of approximately five per cent sodium hydroxide solution. The third impinger is dry. The sulfur dioxide gas passes through the thimble and is collected in the impingers.

The thimble is extracted with hot water and the solution is titrated with standard sodium hydroxide solution to determine the sulfur trioxide. The sulfur dioxide collected in the impingers is determined by oxidation with bromine, acidification, and precipitation as barium sulfate.

6. Ammonia

The sampling train for ammonia consists of three series-connected impingers immersed in an ice bath followed by a dry gas meter and a pump. The first two impingers contain 100 ml. each of approximately five per cent hydrochloric acid solution. The third impinger is dry.

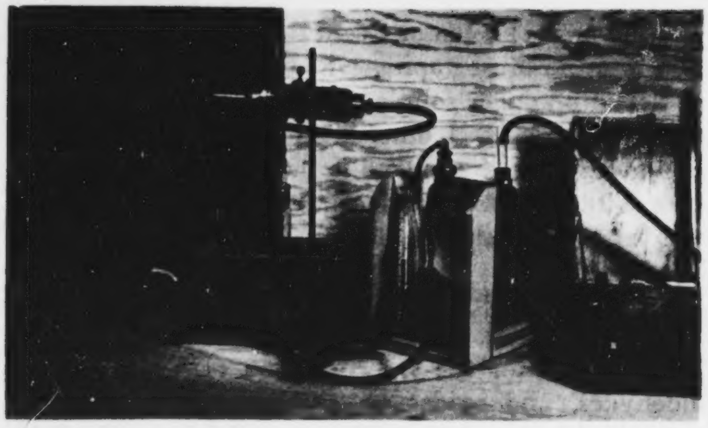

Figure XI 7 Sampling train using miniature glass cyclone, alundum thimble, and impingers. Meter and pump complete the train.

The ammonia is determined by a modified Kjeldahl distillation method. An excess quantity of sodium hydroxide is added to the impinger solution and the ammonia is distilled into a measured volume of standard acid. The excess acid is titrated with a standard base to obtain the ammonia content.

Ammonia is not normally found in the flue gases from combustion sources. Tests for ammonia are made only in special cases where its presence might be suspected. For example, it has been found that flue gases from catalytic cracking regenerators contain ammonia.

7. Organic Acids

The sampling train for organic acids consists of three series-connected impingers followed by a dry gas meter and a pump. The first two impingers contain

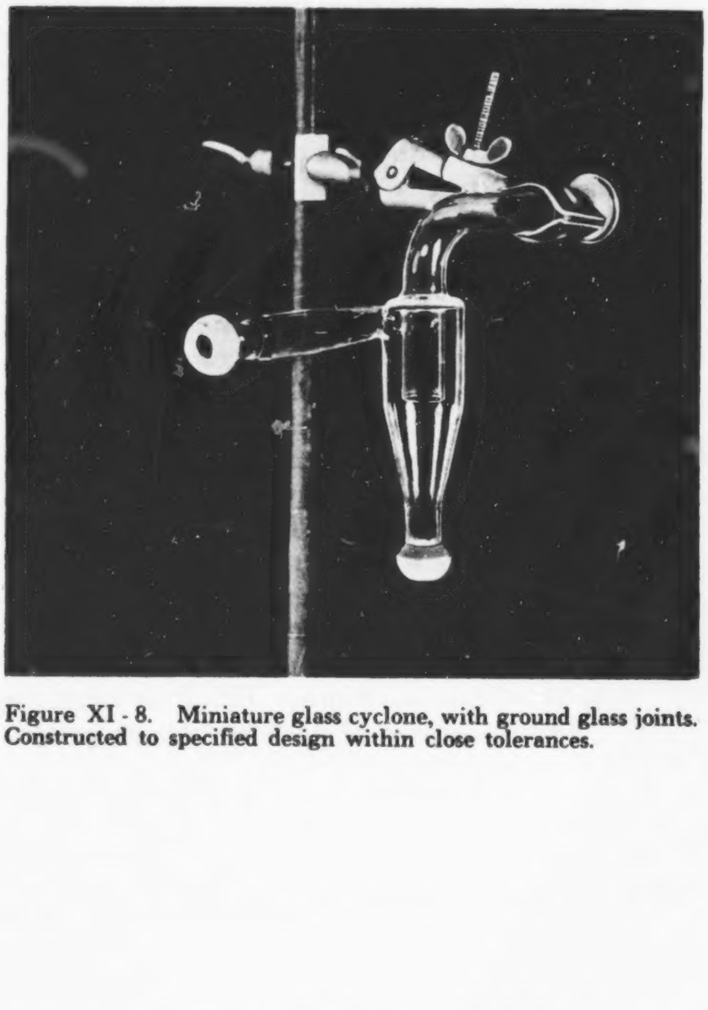

Figure XI - 8. Miniature glass cyclone, with ground glass joints. Constructed to specified design within close tolerances.

100 ml. each of a five per cent sodium hydroxide solution and the third impinger is dry.

The impinger solution is acidified to a pH of two and is extracted with ether in a liquid-liquid extraction apparatus. Water is added to the extract and the mixture is titrated with standard sodium hydroxide solution to the phenolphthalein end point.

8. Hydrocarbons, Aldehydes, Oxides of Nitrogen

Samples for the determination of hydrocarbons, aldehydes, and oxides of nitrogen are collected in evacuated bulbs. At least four samples for each of the gases are taken during a one-hour test period. The bulbs for hydrocarbon samples are used dry; for aldehyde samples they contain sodium bisulfite absorbing solution; and for oxides of nitrogen they contain a mixture of hydrogen peroxide and 0.1 N sulfuric acid.

The hydrocarbons are determined by an infrared spectrophotometer and the results are expressed as hexane.(7)

The aldehydes are determined by a modified Ripper's method(8) and are expressed as formaldehyde.

The oxides of nitrogen are determined by the phenol disulfonic acid method (9, 10, 11) and reported as nitrogen dioxide. Both the nitric oxide and nitrogen dioxide which may be present are measured by this method.

F. *Requesting Source Testing*

The field inspector, as a practical matter, is interested in sampling or testing "invisible" contaminants in two basic types of situation:

1. To determine compliance with maximum permissible emission regulations rules: 52, 53, and 54.
2. To identify and measure, if possible, any suspicious contaminant emitted from a source and which may be involved in an air pollution problem.

We shall deal with these as they relate to source sampling and testing.

1. "Invisible" Contaminant Rules

The invisible contaminant rules are as follows:

Rule 52—This Rule limits the concentration of *all* particulates to 0.4 grains per cubic foot of gas at standard conditions. (A grain is 1/7000 of an avoirdupois pound.)

Rule 53a—Specific Contaminants. This Rule limits sulfur compounds to 0.2 per cent by volume, calculated as sulfur dioxide.

Rule 53b—This Rule limits combustion contaminants to 0.3 grains per cubic foot of gas calculated to 12 per cent of carbon dioxide (CO_2) at standard conditions.

Rule 54—Dusts and Fumes. This Rule limits the total quantities of dusts and fumes emitted per hour according to a graduated schedule of the weight of materials handled in the specific process per hour. The maximum allowable loss permitted by Rule 54 is 40 pounds of dusts and fumes lost for 60,000 or more pounds of material processed. (See Process Weight Table, TABLE XI-1).

TABLE XI-1
RULE 54 PROCESS WEIGHT TABLE

*PROCESS WT/HR (LBS)	MAXIMUM WEIGHT DISCH/HR (LBS)	*PROCESS WT/HR (LBS)	MAXIMUM WEIGHT DISCH/HR (LBS)
50	.24	3400	5.44
100	.46	3500	5.52
150	.66	3600	5.61
200	.852	3700	5.69
250	1.03	3800	5.77
300	1.20	3900	5.85
350	1.35	4000	5.93
400	1.50	4100	6.01
450	1.63	4200	6.08
500	1.77	4300	6.15
550	1.89	4400	6.22
600	2.01	4500	6.30
650	2.12	4600	6.37
700	2.24	4700	6.45
750	2.34	4800	6.52
800	2.43	4900	6.60
850	2.53	5000	6.67
900	2.62	5500	7.03
950	2.72	6000	7.37
1000	2.80	6500	7.71
1100	2.97	7000	8.05
1200	3.12	7500	8.39
1300	3.26	8000	8.71
1400	3.40	8500	9.03
1500	3.54	9000	9.36
1600	3.66	9500	9.67
1700	3.79	10000	10.0
1800	3.91	11000	10.63
1900	4.03	12000	11.28
2000	4.14	13000	11.89
2100	4.24	14000	12.50
2200	4.34	15000	13.13
2300	4.44	16000	13.74
2400	4.55	17000	14.36
2500	4.64	18000	14.97
2600	4.74	19000	15.58
2700	4.84	20000	16.19
2800	4.92	30000	22.22
2900	5.02	40000	28.3
3000	5.10	50000	34.3
3100	5.18	60000	40.0
3200	5.27	or	
3300	5.36	more	

Determination of compliance with these contaminant rules is not ventured by the inspector, but by a special test team. Conditions and criteria for reasonable suspicion of violations, however, exist. For example, where solid and liquid particulates, such as dusts and mists are distinctly visible as a plume emitted from a specific stack, duct or source, a violation of Rules 52, 53b, or 54 may be reasonably suspected. An opacity of 20% or more, excluding water vapor or steam which may be included in the plume, is sufficient to suspect a violation. This suspicion may be reinforced if such other factors as poor operating procedures, low-grade fuels, inefficient processing, or public nuisances are involved. In the case of Rule 54, an excessive visible discharge in relation to a relatively small rate of material processing may strongly indicate the possibility of a violation. An experienced inspector will be able to learn from an examination of the entire air pollution configuration whether or not the operation or design of equipment is extraordinary. Suspicious operation of equipment can be checked against conditions stated on operating permits. Should a test be necessary, the operating conditions of equipment at the time of the opacity or suspicion of violation should be noted.

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* Rule 2j. *Process Weight per Hour.* "Process Weight" is the total weight of all materials introduced into any specific process which process may cause any discharge into the atmosphere. Solid fuels charged will be considered as part of the process weight, but liquid and gaseous fuels and combustion air will not. "The Process Weight per Hour" will be derived by dividing the total process weight by the number of hours in one complete operation from the beginning of any given process to the completion thereof, excluding any time during which the equipment is idle.

In most instances in the burning of liquid, gaseous or solid sulfur-bearing fuels, enforcement of Rule 53a is obviated by Rule 62, Sulfur Content of Fuels, which fixes the sulfur content of fuel below that which would yield the excessive gaseous concentration prohibited in Rule 53a. A fuel regulation thus tackles the problem more directly at the source than does a maximum permissible emission. Rule 53a, however, is still useful in enforcement, especially at sources which involve the processing of sulfur-bearing materials rather than the combustion of fuels. This includes acid plants which make sulfur and certain refinery or petrochemical operations such as the burning of tail gases of hydrogen sulfide to produce sodium and calcium polysulfides. Also, Rule 53a must still be currently applied during the periods of the year when Rule 62 is not in force.

The best estimation that can be made in terms of the probability of violation of Rule 53a is by observation of the plume. There are several simple rules which can be remembered in the formation of plumes resulting from the combustion of materials containing sulfur.

1. The complete combustion of sulfur or hydrogen sulfide yields twice its weight in sulfur dioxide gas.
2. Approximately 3-5% of the total gas volume of sulfur dioxide consists of sulfur trioxide (SO_3).
3. Sulfur trioxide generally becomes visible at approximately 20 parts per million. The plume opacity is "trace" or about 5%. This means that a 5% plume will contain about .04% of sulfur dioxide, far below a violation, but enough to warrant sampling and testing. Of course, as the opacity of the plume increases, so will the probability of violation.

Since sulfur dioxide and hydrogen sulfide are gases, the inspector is not handicapped by the necessity to perform isokinetic sampling. All that he need do is take a representative sample by squeeze bulb, Tutweiler or iodometric methods, as described in the "On-the-spot" section of this chapter. These "portable" methods are generally accurate within a 10% degree of error. Where concentrations are significantly more than ten per cent above that prohibited as disclosed by the use of such test equipment a definite violation can be proven in court.

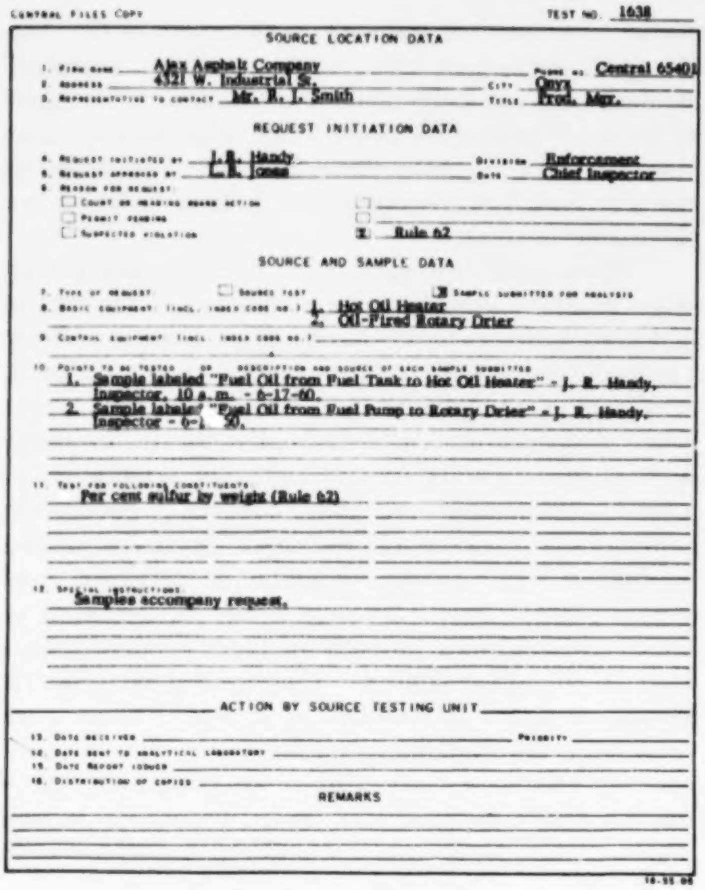
These field determinations, however, are not always practical due to the inconvenience or the lack of sampling facilities at all sources of air pollution. They are mostly conducted at oil refineries, chemical plants, and large power generating stations, where the conditions of operations are well known by the inspector and where variables in operation are readily ascertained. Stationary sampling facilities, permanent sample lines, air compressors, steam lines, and testing equipment are usually available at refineries and power plants. Since tests may not be practical at smaller installations, in extreme cases stationary tests may be requested from the Engineering Division. It should be noted that violations of Rule 53a in other than large installations or refineries are rare. The inspector, therefore, may still more effectively apply Section 24242, Ringelmann smoke density, or Section 24243, Public Nuisance, if one exists, in preference to Rule 53a.

2. Suspicious Contaminants — Grab Samples

Occasionally, an inspector may desire to merely sample a contaminant, whether gaseous or particulate, for identification in the investigation of a special problem or a public nuisance. A gas sample may merely be taken by means of a sample probe and impinger with an aspirator, or by an evacuated flask, syringe, etc., according to methods previously described. The samples can then be brought to the laboratory for analysis.

3. Requesting Source Testing

All requests for tests are made on the form "Request For Test And/Or Analysis" shown in Figure XI-9. This form may be used to initiate tests by the Inspector, Senior Inspector, or any member in the chain of command, should such a test be warranted. The Senior Engineering Inspector carefully reviews the reasons for testing as well as the conditions under which the tests should be conducted. Judgment must be used in determining whether or not there is sufficient cause for testing, since testing is expensive. Most air pollution problems not involving permit processing are resolved without source testing even when invisible contaminants are involved. As a matter of practical expedience the inspector can adequately determine air pollution problems through design and operational and maintenance practices and bring them to the attention of management. When a chronic or serious air pollution problem is presented by the emission of invisible particulates which may cause public nuisances or complaints, however, and no other means is



CENTRAL FILES COPY

TEST NO. 1638

SOURCE LOCATION DATA

1. FIRM NAME Alex Asphalt Company PHONE NO. Central 65401
2. ADDRESS 4321 W. Industrial St. CITY Onyx
3. REPRESENTATIVE TO CONTACT Mr. R. I. Smith TITLE Prod. Mgr.

REQUEST INITIATION DATA

4. REQUEST INITIATED BY J. R. Handy DIVISION Enforcement
5. REQUEST APPROVED BY L. R. Jones DATE Chief Inspector
6. REASON FOR REQUEST:
   - ☐ COURT OR HEARING BOARD ACTION
   - ☐ PERMIT PENDING
   - ☐ SUSPECTED VIOLATION
   - ☐
   - ☐
   - ☒ Rule 62

SOURCE AND SAMPLE DATA

7. TYPE OF REQUEST ☐ SOURCE TEST ☒ SAMPLE SUBMITTED FOR ANALYSIS
8. BASIC EQUIPMENT (INCL. INDEX CODE NO.) 1. Hot Oil Heater 2. Oil-Fired Rotary Drier
9. CONTROL EQUIPMENT (INCL. INDEX CODE NO.)
10. POINTS TO BE TESTED OR DESCRIPTION AND SOURCE OF EACH SAMPLE SUBMITTED
    1. Sample labeled "Fuel Oil from Fuel Tank to Hot Oil Heater" - J. R. Handy, Inspector, 10 a.m. - 6-17-60.
    2. Sample labeled "Fuel Oil from Fuel Pump to Rotary Drier" - J. R. Handy, Inspector - 6-1[illegible]60.
11. TEST FOR FOLLOWING CONSTITUENTS
    Per cent sulfur by weight (Rule 62)
12. SPECIAL INSTRUCTIONS:
    Samples accompany request.

ACTION BY SOURCE TESTING UNIT

13. DATE RECEIVED PRIORITY
14. DATE SENT TO ANALYTICAL LABORATORY
15. DATE REPORT ISSUED
16. DISTRIBUTION OF COPIES

REMARKS

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Figure XI - 9. Request for source test or sample analysis.

available for controlling the source through the usual enforcement methods, source testing is indicated.

All requests for tests are reviewed again by the Engineering Evaluation and Planning Division before action is taken. The review is made to obtain the maximum useful information per test. For example, the Enforcement Division might request a test on a multiple-chamber incinerator for combustion contaminants to determine compliance with Rule 53b. The Evaluation and Planning Staff might make additions to the request to obtain information on aldehydes or oxides of nitrogen for total air pollution studies.

The operating conditions of the equipment are specified on the test request form by the person originating the request. On an incinerator, these conditions might include, for example, the type of material to be burned, the burning rate, and the cycle of operation, such as start-up or burndown.

II TOXICITY AND PHYSIOLOGICAL RESPONSE

Concentrations of air contaminants may be measured not only by the use of specially designed instruments, but by their effects on life and property. In fact, minute traces of some contaminants may often be immeasurable, or difficult to measure, and are only detected by their environmental effects. Odors, for example, may be produced by minute quantities of airborne materials, such as mercaptans, which otherwise do not reduce visibility or cause any significant damage to property. Some contaminants, such as hydrogen sulfide attack lead-based paints. Other contaminants may have toxic effects on humans and various species of vegetation. The extent to which these effects are created, or the type of nuisance or hazard effect evidenced such as corrosion, irritation, odor, systemic poisoning, or other biological effects on living organisms are in themselves a means of identifying and measuring the concentrations of many types of contaminants in the air dispersed from a nearby source. We shall treat here the physiological reactions to toxic substances.

Although the most common effect expected of toxic materials is irritation, there are many others, i.e., the sensation of pressure experienced on the mucosa in some persons due to the presence of ozone; headaches associated with carbon monoxide; increased breathing rate due to carbon dioxide; the loss of sensual perception due to fatigue or anaesthesia as in the case of higher concentrations of hydrogren sulfide or gasoline fumes. Other toxicants are even more insiduous, exhibiting no immediate effect, but marked suffering after several hours or days.

Identification and concentration of air contaminants in terms of biological influences are made in terms of the concept of the *threshold*. A threshold is that concentration of a contaminant which is just barely detectable in the effect that concentration has on an organism. Thus an *odor threshold* is the lowest concentration of a contaminant at which its odor is first detected. The odor threshold quite often is used as a reference point in roughly estimating the concentration of air contaminants. Similarly, a threshold will exist for other physiological responses such as those symptoms and sensations described in the preceding paragraph.

There are two general types of thresholds of use in the fields of industrial hygiene and air pollution control. These are odor thresholds and toxic or eight-hour working thresholds established as safety standards for certain occupations. The latter is referred to as the Maximum Allowable Concentration (the MAC). Such thresholds are investigated and established to guide governmental agencies and others concerned by the Committee on Threshold Limits, American Conference of Governmental Hygienists.23) More recently, a greater interest is being shown on the effects of low concentrations of air contaminants in metropolitan areas for the purpose of establishing air quality standards. The information supplied from this general field is very useful to the inspector. Odor thresholds are of particular value in that some gases give odor warning before a toxic level is reached, such as hydrogen sulfide and sulfur dioxide, whereas such gases as carbon monoxide and arsine give no warning.

Threshold data, therefore, has two fundamental uses for the field inspector.

1. **Identification and estimation of contaminant concentration involved in enforcement problems such as public nuisances.**
2. **Estimation of hazardous concentrations of contaminants in an area for the inspector's protection. In all dangerous situations, the safest thing to do is to remove oneself from the contaminated area or to put on protective equipment if the presence of dangerous material can be perceived.**

Thresholds and other important data regarding some gases encountered by A.P.C.D. personnel, along with data regarding testing techniques were compiled by Clawson12) as follows:

ALDEHYDES

FORMALDEHYDE, HCHO (METHANOL)	ACROLEIN, $CH_2=CHCHO$ (PROPENOL)
PROPERTIES: A colorless gas with density of 0.815; soluble in H_2O(15); very reactive, explosive limits: 7%-73%.	A colorless liquid; boiling point 126.5°F. Solubility: 1 part acrolein in 3 parts H_2O. A colorless gas with density of 1.9(15).

ODOR:
Suffocating, pungent, irritating, (15) choking (26). (These aldehydes, at threshold levels, are probably perceived by reason of their irritating quality rather than by the sense of smell.)

SOURCES:

Occurs in a great diversity of industries as raw material, product and/or by-product(15).	Results from thermal decomposition of fats, oil or glycerol (15). Used as war gas in World War I.

ATTACK:
The toxic effect of these compounds (especially formaldehyde) is the denaturing of tissue (especially mucous membrane) proteins. Formaldehyde is more soluble and exerts the greatest effect on upper respiratory tract(14) (can lead to death by edema or spasm of larynx)(13). Acrolein can cause death by pulmonary edema, respiratory paralysis(13). Both are powerful irritants of eyes, respiratory tract and skin(13) (14).

SYMPTOMS:
Sneezing, coughing, salivation, eye irritation with lachrymation (especially acrolein)(25). Bronchial catarrh, conjunctivitis. Some individuals become highly sensitized to formaldehyde, leading to asthma or skin disorders on later exposures(13).

REMARKS:
GOOD WARNING CHARACTERISTICS, due to strong irritation. Concentrations not immediately dangerous to life can become intolerable in a very short time.

TOXICITY:

CONC.: PPM	RESPONSE
0.25	Eye irritation(22).
5	Max. allowable conc., 8 hr.(23).
200	For 3½ hr.: quick recovery (animal) (25).
650	For 4 hrs. lung, eye irritation, recovery
650	8 hr. edema & hemorrhage, death
1600	4 hr. edema & hemorrhage, death
4900	3 hr. edema & hemorrhage, fatal.

(Responses to concentrations above 200 ppm are from animal studies: cat)

CONC.: PPM	RESPONSE
0.5	Max. allowable conc., 8 hr(23).
0.5-1.5	Eye irritations threshold
1.8	"Odor" threshold(23)
1.0	Eye & nose irritation in 3 min.
5.5	Eye & nose irritation in 20 sec., intolerable in 1 min.
10	Lethal to most animals in a few min.(13).
153	Fatal to man in 10 min.(25).

PLANT DAMAGE: 30 ppm for 24 hrs. killed plants(22).

TEST:
Goldman & Yagoda Bisulfite Method(13) Ind. & Chem. Anal., ed. 15-377, 1943.

AMMONIA, NH_3

CHARACTERISTICS:
Colorless gas, density 0.597 × air(13). Extremely soluble in water (to 29%)(13). Easily liquefied by pressure. L.E.L. 16% NH_3 by vol.(15). Corrosive to copper, brass, aluminum and zinc.

ODOR:
Pungent and irritating(13) characteristic.

SOURCES:
Many uses, especially in refrigeration(18). Also used in textile, dye-making, explosive, lacquer, fertilizer, etc., industries(13).

ATTACKS:
Upper respiratory tract, moist eye tissues(13). High conc. (above 2%) will produce chem. burns on wet skin(19).

SYMPTOMS:
Violent respiratory reflexes, as coughing and arrest of breathing(13). Secretion of saliva; eye irritation(13).

REMARKS:
Good warning properties, since odor threshold is below injurious concentration(13).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
53	Odor threshold(13)
100	Maximum allowable conc., for eight hrs.(23).
300	Maximum allowable conc., one hour(13).
408	Least conc. causing throat irritation (13) (14).
698	Least conc. causing immed. eye irritation (13).
·1720	Least conc. causing coughing(13).
5000 to 10,000	Rapidly fatal for short exposure(14).
2% to 3%	Can cause chemical burns on wet skin(19).

TESTS:
Expose red litmus paper moistened with water in suspect atmosphere(15):

CONCENTRATION (P.P.M.)	LITMUS TURNS BLUE IN:
1	70 sec.
10	6.5 sec.
100	1 sec.
1000	Immediately

Also: Sense of smell is good gauge of conc.(15).

Also: Draw suspect air through 0.01N sulfuric acid (with methyl(13) red indicator), at a known rate, until indicator changes. Conc. of NH_3 can be calculated, knowing air volume of sample.

ARSINE, AsH_3

PROPERTIES:
A colorless gas with a density of 2.7 × air(17), solubility is 20 vol. AsH_3 in 100 vol. H_2O at 20° C. Arsine is inflammable.

ODOR:
Slight garlic-like odor(17).

SOURCES:
Results whenever nascent hydrogen is formed in a solution containing arsenic(25). Thus, it can occur in any soldering, pickling, etching or plating process involving metals or acids containing arsenic(15). Possible in manufacturing of zinc chloride, HCL, H_2SO_4 and smelting of arsenic containing ores(13).

ATTACK:
Arsine has an affinity for hemoglobin of the red blood cells. After it is absorbed by these cells it is oxidized to arsenic oxide which causes hemolysis (breakdown) of the red cells. If severe, this hemolysis results in great diminution of red cell count, kidney damage due to clogging by cellular debris, and jaundice(14) as it is absorbed through the lungs.

SYMPTOMS:
Acute: Starts with feeling of illness and weakness, followed by nausea, vomiting and epigastric pains. Vomiting becomes continuous and productive of blood(14). Urine can be dark, bloody and/or completely retained. After a day or two, severe jaundice and cyanosis and death may occur. Symptoms usually start 4 hrs. or more after exposure(14); sometimes 1 or 2 days(13). Chronic: Yellowness of skin, hemoglobin in urine(14), malaise(16) (13).

REMARKS:

Poor warning characteristics, despite low odor threshold, because of extreme toxicity of low concentrations(25).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
0.05	Maximum allowable conc., 8 hrs.(22)
0.5	Odor threshold(22)
3.1	Maximum allowable conc. for several hrs. without serious effects(13)
1 to 10	Probably dangerous(17)
100 to 200	Immediately hazardous to life(17)
250	Fatal after ½ to 1 hr.(14)
500	Lethal in a few minutes(13)

TESTS:

Mercuric chloride test papers(16)
Silver nitrate test papers(16)
Detection tubes containing silica gel impregnated with $AgNO_3$, for squeeze bulb aspirators, are in prospect.

CARBON DIOXIDE, CO_2

CHARACTERISTICS:

A colorless gas, density 1.529 × air(13), (15).

ODOR:

Odorless(13), (15), (however, at concentrations above 5% it is perceptible by its physiological actions).

SOURCES:

Utilized widely in the solid state (dry ice) as a refrigerant(15). Occurs universally in gases from combustion of carbonaceous material(13). Respiratory CO_2 can be a hazard to workers in confined places(13). Also present in onion shipments in ships' holds. CO_2 is used in, or produced by many industries.

ATTACK:

CO_2 is always present in the blood as a normal metabolic product. It is the primary respiratory stimulus. High concentrations cause increased and labored breathing, unconsciousness and, ultimately, death(13).

REMARKS:

CO_2 is toxic only in abnormally high concentrations which result in overstimulation and ultimate paralysis of the respiratory center (13). However, as a constituent of "black damp", with nitrogen, it can act as a simple asphyxiant by excluding oxygen(13), (15).

SYMPTOMS:

Respiration rate increases with CO_2 concentration to the point of respiratory exhaustion and paralysis(13).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
5,000	Maximum allowable concentration(23)
20,000	5% increase in lung ventilation(13)
30,000	100% increase in lung ventilation(13)
50,000	300% increase in lung ventilation(13)
100,000 (10%)	Can be endured for only a few minutes(13)
120,000-150,000 (12%-15%)	Unconsciousness(13)
250,000 (25%)	After several hrs. death may occur(13)

TEST:

Fyrite CO_2 tester volumetric: absorption of CO_2 in base, then measurement of residual gases.

CARBON MONOXIDE — CO

CHARACTERISTICS:

A colorless gas with density 0.967 times that of air(13). Explosive limits: 12.5 to 24% CO(13).

ODOR:

None(13); practically odorless(15); slight garlic-like odor, seldom noticed(2).

SOURCES:

The most universally distributed toxic gas(13). Likely to be present wherever carbon or organic compounds and fuels are burned (due to incomplete combustion)(13). The greatest single nonindustrial hazard, it causes casualties in residences, garages and vehicles, as well as in industries(13). High concentration in steel and aluminum furnaces(13). In one study the average conc. in automobile exhaust gases was 7% CO(13). Enclosed warehouses and freezers using internal combustion fork trucks.

ATTACK:

Nonirritating and nontoxic to tissues, CO produces its damage by combining preferentially with hemoglobin of the blood, thus excluding oxygen from the tissues and leading to asphyxiation of the cells, especially nerve cells(13). Affinity of CO for hemoglobin is 300 times that of oxygen(10).

REMARKS:

Insidious because of poor warning characteristics (due to absence of odor, and mildness of symptoms preceding very dangerous blood levels, especially at high concentrations(13). Factors causing rapid breathing lead to increased absorption of CO in the blood(13). Cannister (activated carbon) "gas masks" cannot be relied on for protection against CO(16).

SYMPTOMS:

Dizziness, headache, discomfort, weakness, heart palpitation, staggering, confusion of mind, nausea, vomiting, unconsciousness, convulsion, weak pulse and slow respiration(13).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
100	Allowable for eight hrs.(23).
200	Headache, dizziness, palpitation after 2 hrs. (active individual)(16).
400	Headache and discomfort in 2-3 hrs.(13).
500	Headache and discomfort in one hr. (active individual).
600-700	Slight effect after one hr.
1000-12000	Confusion, nausea in 2 hrs.(14).
	Palpitation in 30 min. with light exercise(13).
	Long exposure could be fatal(16).
1500-2000	Dangerous for 1 hr. exposure(13).
2000-2500	Unconsciousness in 30 min.(13).
4000+	Fatal in 1 hr.(13).
10,000	Symptoms in 3-5 min., rapidly worsening(16).
Very high conc.	No warning before collapse.

The above indications of toxicity can be quite variable because factors other than time and concentration affect blood levels of carbon monoxy-hemoglobin (including respiration rate and sometimes acclimatization to low CO concentration)(14).

The following rule of thumb is brief and useful:

Time (in hrs.) × concentration (p.p.m.) = 300—no appreciable effect(2).
Time × concentration = 600 — barely appreciable effect
Time × concentration = 900 — headache and nausea
Time × concentration = 1500 — dangerous

TESTS:

M.S.A. Squeeze bulb aspirator with CO detecting tubes (10 P.P.M.)
J - W combustible gas indicator 1000 to 70,000 p.p.m. (0.1% to 7%)

CHLORINE, Cl_2

PROPERTIES:

A greenish-yellow gas(15), density 2.44 × air(3). Not explosive or inflammable(21), solubility at 20°C. is 2.15 volumes Cl_2, in 1 vol. of water (13). Corrosive to most metals in moisture only(21). It is easily liquefied by pressure(13).

ODOR:

Characteristic choking, pungent odor, irritating to nose and throat(1).

SOURCES:

In manufacture by electrolysis(13), used as a bleach for cotton, flour, etc.(14). Also a hazard where used as a water purifier and in production of bleach and organic chemicals(13), para-dichlorobenzene, phenol.

ATTACK:

Cl_2 attacks the entire respiratory tract as well as mucous membranes of the eyes(13), (14). It produces irritation, then inflammation of the affected tissue, and after severe exposure, edema of the lung(13), which can result in death. Liquid Cl_2 can cause skin burns(21).

SYMPTOMS:

Coughing, eye-irritation, labored breathing, general excitement, restlessness, throat irritation, sneezing, copious salivation, retching, vomiting, extremely difficult breathing(21).

REMARKS:

Although its odor threshold is above the maximum allowable concentration (8 hrs.) (14), Cl_2 is considered to have adequate warning properties of dangerous concentrations(13). Effects are not cumulative and complete recovery from mild exposures can be expected(21). It is 20 times as toxic as HCL gas and probably does most tissue damage by oxidation(14).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
1.0	Maximum allowable conc., 8 hr.(23).
3.5	Odor threshold(22)
4.0	Max. allowable conc. for short exposure (1½-1 hr.)(14).
15	Least conc. causing throat irritation(14).
30	Least conc. causing coughing(21).
40-60	Dangerous in ½-1 hr.(21).
1000	Short exposure(2), (a few deep breaths) can be fatal.

PLANT DAMAGE:

0.46	Minimum conc. causing damage to buckwheat.

TESTS:

Bubble suspect atmosphere through a midget impinger containing o-tolidine sol. Intensity of yellow color is then matched with standards(13). This test can be disturbed by Fe, manganic Mn, NO_2(13). There are in prospect o-tolidine indicator tubes for squeeze bulb aspirator. NH_4OH can be used for tracing and locating CL_2 leaks.

HYDROGEN CYANIDE, HCN

(Hydrocyanic Acid, Prussic Acid)

PROPERTIES:

A water-white(19), exceedingly volatile liquid with a boiling point of 26°C(13) infinitely soluble in water(17); a colorless gas(13) with a vapor density, relative to air, of 0.93(17).

ODOR:

Penetrating(13), bitter almonds(17), sweetish bitter almonds(19).

SOURCES:

Used extensively in fumigation(14). Can be evolved from metal plating operations(13), found in other industries, incl. blast furnaces, dye stuffs works, mining, etc.(13), used as a reagent in organic chem. mfg. and chemical laboratories(13).

ATTACK:

A "Protoplasmic poison"(14), HCN is a chemical asphyxiant(15), which interferes with the oxidation processes of tissue cells(14). As with other types of asphyxiation, nerve cells are most susceptible and HCN deaths result from paralysis of the respiratory center of the brain(16). It is absorbed, either as liquid or gas, by any living body tissue, including the intact skin, but is most dangerous on inhalation(16). Acute HCN asphyxia is one of the most rapid causes of death(19).

REMARKS:

HCN has relatively poor warning properties because it is not an irritant(13), and the odor is easily missed(16). It is exceedingly hazardous for acute exposure(17), but recovery from mild poisoning is rapid and complete(19). In acute cases, venous blood assumes the bright color of arterial blood(19). HCN is a powerful respiratory stimulus(14).

SYMPTOMS:

High concentration: rapidly developing giddiness, severe headache, unconsciousness, convulsions(13), (16), (19). Lower concentrations: irritation and dryness and constriction of throat, indistinct vision, sweating, palpitation, headache(19).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
1	Odor threshold (of trained personnel)(5).
10	Maximum allowable conc. for 8 hrs.(23).
20	Slight symptoms after several hours(13).
50-60	Safe for one hr.(17).
100	Very dangerous in one hr.
300	Death possible from few minutes exposure
200-480	Fatal after 30 minutes(14). (19).
2000	Fatal(13).
3000	Rapidly fatal(17).

TESTS:

M.S.A. Hydrocyanic gas detector (simplest but not entirely specific for HCN); phenolphthalin field method (not specific)(13). Bicarbonate iodine method(13), (requires titration).

HYDROGEN FLUORIDE, HF

(HYDROFLUORIC ACID)

PROPERTIES:

Below 67°F.: A colorless, noninflammable, fuming liquid(19), very soluble in water. Above 67°F.: A colorless, noninflammable gas(19), of density 0.71(15), which fumes in moist air and is reactive and corrosive to many substances.

ODORS:

Pungent, irritating; sharp and penetrating(9).

SOURCES:

Used as a catalyst in some petroleum refining processes (isomerization); also in etching glass, silicate extraction, phosphorus extraction, gold refining. A by-product in electrolytic production of aluminum and processing of phosphate rock for fertilizer.

ATTACK:

Tissue damage is caused primarily by strong acid properties, but the fluoride ion is a protoplasmic poison as well(14). This acid has a strong irritant and corrosive action on all body tissues(13). Inhalation can lead to respiratory tract inflammation, lung edema and death(19). Skin and (especially) eye contact with vapors or liquid can lead to slow-healing, painful ulcers or even total destruction of involved tissue(19). Ingestion yields G. I. tract damage(19).

SYMPTOMS:

Inhalation: Constricted breathing, coughing, throat irritation, ulceration of mucous membranes, pulmonary edema(1). *Contact*: high concentrations cause immediate severe pain and result in deep ulcers. Low concentrations can result in the slow-healing ulcers but without the pain accompanying exposure. Chronic exposure to low concentrations can lead to fluoride poisoning(17).

REMARKS:

GOOD WARNING PROPERTIES at immediately dangerous levels, due to irritating odor. A temporarily trapped victim might save life by breathing through dry cloth or clothing. High danger of burns.

TOXICITY:

CONCENTRATION (P.P.M.)	
3	Maximum allowable conc., 8 hr.(15), (23).
10	" " " ½ - 1 hr.(20).
30	Sour taste, smarting of eyes for several min.(25).
60	" " apparent, irritation of eyes and nose(25).
120	Same, including irritation of skin(25), respiratory tract.
50-250	Dangerous for short exposure.
1800	Fatal to animals within 5 min.(25).

PLANT DAMAGE:

0.1 ppm for 3-4 hrs. yields minimal effects.

TEST:

M.S.A. Hydrogen fluoride detector.

HYDROGEN SULFIDE, H_2S

PROPERTIES:

A colorless gas with a density, 1.19(15) × air, explosive limits are 4.3%-46% by vol.(19). It is corrosive to many metals(19). Solubility is 3 volumes H_2S to one vol. H_2O at room temperature(19).

ODOR:

Characteristic foul odor of rotten eggs(19). Not reliable as warning of *dangerous* concentrations(19).

SOURCES:

Refinery gases, crude oil(13). Sulfur recovery plants. Some metallurgical processes(15). Various chemical industries using sulfur-containing compounds(15). Certain "mineral" waters. Decomposition of organic material (as sewage wastes)(14).

ATTACK:

Irritating to eyes and respiratory tract(19). H_2S blocks oxidative processes of tissue cells (probably by enzyme poisoning)(18), thus affecting early the susceptible nerve cells and leading ultimately to death through paralysis of the respiratory center of the brain(19).

SYMPTOMS:

Acute: Slow heart respiratory increase, respiratory paralysis, convulsions, death(18). Subacute: Headache, sleeplessness, dizziness, pain in eyes, conjunctivitis.

REMARKS:

Though the odor of H_2S is readily recognizable in low concentrations, detection of dangerous concentrations by smell is unreliable and unsafe because of olfactory fatigue, which occurs quickly at high concentrations; and also occurs, though slowly, at lower concentrations(16).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
0.13-1.0	Odor threshold(22), (17).
20	Maximum allowable conc., 8 hrs.(23).
100	Olfactory fatigue in 2-15 min.(17).
	Irritation of eyes and resp. tract after 1 hr.(16).
	Death in 8-48 hrs.(18).
170-300	Maximum allowable for 1 hr.(19).
	Eye irritation in 6-8 minutes(13).
400-700	Dangerous after 30 minutes - 1 hr.(19).
600+	Fatal in 30 minutes(19).
700-900	Rapid unconsciousness, respiratory arrest and death(18).
1000+	Immediate unconsciousness and rapid death(16).

TESTS:

M.S.A. squeeze bulb aspirator with H_2s detection tubes.
Lead acetate ampules (for warning purposes).
Lead acetate paper (warning or can be quantitative).

NITROGEN OXIDES (Nitrous Fumes)

REMARKS(14):

There are many oxides of nitrogen. Of the total, only two need be considered as common toxicants in air pollution and industry. These are nitrogen dioxide NO_2 (or nitrogen tetroxide, or peroxide N_2O_4, its isomeric form) and nitric oxide NO. Nitric oxide is oxidized further to nitrogen dioxide ($2NO + O_2 \rightarrow 2NO_2$).

PROPERTIES(14):

The equilibrium $2\ NO_2 \rightleftarrows N_2O_4$ favors nitrogen dioxide as the temperature increases. At 40°C., the mixture is a yellow to brown gas, depending on concentration. The density is 1.59 × air. It is soluble in water, forming nitric acid. The gas is corrosive to many metals. Does not form explosive mixtures with air(17).

ODOR(17):

Pungent, sweetish.

SOURCES:

A product of high temperature combustion. Also found as product or by-product in the following industries: Metal cleaning, fertilizer, explosive(15), nitric acid(16), mfg. H_2SO_4 (by chamber process)(13), photographic film, carbon arc combustion(13). It is also formed by the action of nitric acid on oxidizable materials(14).

ATTACK:

An irritant gas (15), NO_2 produces its injury by reacting with the alkalies of lung tissues(14). In sufficient amounts this leads to edema of the lungs which can result in death(17). The edema may arise a number of hours after exposure.

SYMPTOMS:

NO_2 is among the most INSIDIOUS of gases(14). Since it fails to set up respiratory reflexes(13), a victim may breathe a fatal amount without significant discomfort(14). Hours after an acute exposure, the victim develops a dry cough, shortness of breath and restlessness which can progress to frothy sputum tinged with blood, massive edema and death by "drowning" in body fluids(16). High concentrations may produce moderate irritation and coughing at time of exposure(17).

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
5	Odor threshold(22).
5	Maximum allowable concentration, 8 hrs.(23).
62	Least conc. causing immediate throat irritation(14).
75-100	Visual threshold(17).
100	Least conc. causing coughing(14).
100-150	½-1 hr. dangerous(14), (15).
200-700	Rapidly fatal for short exposure(14).
700	Fatal in 30 minutes or less(13).

Because of POOR WARNING PROPERTIES, it is prudent to leave an area where NO_2 can be smelled or its presence suspected.

TEST:

Suspect air is drawn into an evacuated bottle (to equilibrium) which contains a small amount of Saltzman's reagent. The resulting color change is read on a colorimeter.

OXYGEN, O_2

REMARKS:

Oxygen is not a toxic gas(13), but is included here because its diminution and absence can result in functional impairment and ultimately death by anoxia.

PROPERTIES:

Colorless, active gas.

ODOR:

Odorless.

SOURCES:

O_2 comprises 21% of the atmosphere (14); however, very dangerously low partial pressure of O_2 can occur, from various causes, in enclosed spaces and at extremely high altitudes(14). Other causes of anoxia within the body include mechanical obstructions to breathing(14), drugs which paralyze the respiratory center, and poisons such as carbon monoxide and hydrogen cyanide which prevent tissue utilization of O_2 (14).

ATTACK:

Complete lack of oxygen at the cell level stops the energy yielding processes that are essential to life.

SYMPTOMS:

Progressive impairment of behavior, judgment and self control to unconsciousness, failure of respiration and arrest of heart beat. Lack of O_2 alone is not easily sensed by the victim, thus anoxia acts INSIDIOUSLY(14). Severe nonfatal anoxia may lead to permanent brain tissue damage.

RESPONSE TO REDUCED O_2 TENSION (20):

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
21% (normal atm. conc.)	Normal
12%-16%	Breathing volume increase, pulse rate increased, thinking ability diminished, muscular coordination upset.
9%-14%	Judgment faulty, emotions aroused, irregular respiration.
6%-10%	Nausea, vomiting, bewilderment, loss of consciousness.
6%	Gasping, convulsive movements, cessation of respiration, death.

TESTS:

Pyrite oxygen tester.
(Below 16% O_2 a flame is extinguished)(13).

OZONE, O_3

PROPERTIES:

A colorless gas(17), of low solubility, but of intensely irritating action(14). Density 1.655 × air.

ODOR:

Characteristic pungent odor(17).

SOURCES:

Prepared (technical scale) by exposure of O_2 to brush discharges(13). Used for bleaching (flour, oils, waxes, etc.), for sterilizing drinking water(13). Produced in smog by atmospheric photochemical reactions(17).

ATTACK:

Because of low solubility, O_3 acts primarily on the lungs(20) as a strong irritant(14), and can lead to delayed pulmonary edema and death(17).

SYMPTOMS:

Low concentrations (1+ P.P.M.) produce dryness of eyes and respiratory tract, and headache(17). Higher concentrations can lead to typical symptoms of delayed lung edema(17), (difficulty in breathing, frothy sputum with blood, arrest of breathing, death).

REMARKS:

Although the characteristic odor is easily detectable at very low concentrations, this gas must be considered *insidious*, since physiological reactions are out of proportion to danger accompanying exposure.

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
0.02-0.05	Odor threshold(17).
0.1	Maximum allowable conc., 8 hrs.(17), (23).
1+	Dryness of eyes and respiratory tract(17), headache.
2	Probably safe for a few minutes(17).
50	Might be fatal for 30 min. exposure.

TESTS:

Rubber cracking.

PHOSGENE, $COCl_2$ (Carbonyl Chloride)

CHARACTERISTICS:

A liquid boiling at 8°C(13); at standard conditions a colorless gas of density 3.45 × air(13).

ODOR:

Described as "musty hay"(13); sometimes as "new mown hay".

SOURCES:

Thermal decomposition of chlorinated hydrocarbons(13), (from de-greasers, cleaning plants and CCl_4 used as fire extinguishers); used in manufacturing of dyestuffs, pharmaceuticals, organic chemicals(13).

ATTACKS:

Damages primarily alveolar epithelium, leading to pulmonary edema, often delayed(16).

SYMPTOMS:

Immediate symptoms produced by even a fatal exposure may be mild(13). Elicits no marked respiratory reflexes(13). However, inhalation of higher concentrations produces choking, coughing, slight lachrymation, and tightness of chest(13).

REMARKS:

Possibly fatal concentration can be below odor threshold(16). Thus, poor warning properties.

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
1	Maximum permissible for 8 hr. exp.(23).
3.1	Least conc. that affects throat(14).
4	Least conc. that causes eye irritation(14).
4.8	Least conc. that causes coughing(14).
5	Prob. fatal for 30 min. exposure(16).
5.6	Odor threshold(14).
165	50% mortality on 2 min. exposure(16).

TEST:

Filter paper impregnated with diphenylamine and p-dimethylamino benzaldehyde(13). (Color chart)(16).
Nitroso reagents and other methods(13).

PHOSPHINE, PH_3 (Hydrogen Phosphide)

PROPERTIES:

A colorless gas with density, 1.46 × air(24). Solubility is 26 gm. in 100 gm. of water at 17°C.

ODOR:

Foul odor, slightly resembling decayed fish.(25).

SOURCES:

Action of water on metal phosphides (as with Ca phosphide contaminating Ca carbide in manufacturing acetylene)(13), extraction of phosphorus(25), etc.

ATTACK:

Action on the body is not fully worked out(26). It appears to cause central nervous system depression and irritation of the lungs(26). Necropsy findings sometimes include heart dilation and pulmonary edema(26).

SYMPTOMS:

Acute exposure: Restlessness, tremors, drowsiness, nausea, vomiting(25), gastric pain, diarrhea, thirst(26), substernal coldness and pain(25), bronchitis, lung edema, convulsions and death(25). Chronic: Similar to phosphorus poisoning(25). Anemia, nervous disorders, gastrointestinal disturbances(26).

REMARKS:

Very toxic gas for both acute and chronic exposures(26), warning properties relatively poor for low concentrations.

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
0.05	Maximum allowable conc. 8 hrs.(13), (22), (23).
1.5-3	Minimum perceptible conc.(25)
7	Maximum conc. not causing symptoms in several hrs.(25).
100-200	Maximum allowable concentration, ½-1 hr.(25)
290-430	Dangerous to life after one hr.(25).
400-600	Death can follow exposure of ½-1 hr.(25).
2000	Rapidly fatal.

TESTS:

Meter a known volume of suspect air through a tube packed with silica gel impregnated with silver nitrate, then measure length of black coloration in tube*.

SULFUR DIOXIDE, SO_2 (Sulfurous Acid Anhydride)

PROPERTIES:

A colorless liquid below -10°C., SO_2 is a colorless gas with density 2.26 × air (26), solubility: 79.8. vol. SO_2 to 1.0 vol. H_2O at 0°C.; 18.8 vol. SO_2 is noninflammable and is corrosive to many metals (in moisture).

ODOR:

Characteristic pungent, suffocating odor(26). Odor of "burning sulfur"(25).

SOURCES:

Formed wherever sulfur, sulfur-containing petroleum products, sulfur-bearing coal, etc., are burned in air(25). Mfg. of paper by sulfite process(13). Used as refrigerant, fumigant, etc.(26). Commonly an air contaminant over large cities(18).

ATTACK:

SO_2 is an irritant of the mucous membranes of the respiratory tract and the eyes (15). High concentrations can produce edema of the lungs or glottis and can cause respiratory paralysis. Information on SO_2 metabolism is inadequate(18). Burns from liquid SO_2 result from freezing effect (18).

SYMPTOMS:

Acute: Lower concentrations, sore throat, cough, high concentration, hoarseness, oppression and pain in chest, difficulty in swallowing; very high concentration, acute bronchitis, pulmonary edema, cyanosis and death(18). Chronic: Pallor, anorexia(18), increased nasopharyngitis, upset of taste and smell(25).

REMARKS:

Good warning characteristics, since it readily elicits respiratory reflexes(13). High concentrations become intolerable before reaching immediately dangerous levels. No apparent irreversible damage from chronic or nonfatal exposures.

TOXICITY:

CONCENTRATION (P.P.M.)	PHYSIOLOGICAL RESPONSE
.03-1.0	Threshold (probably taste)(26).
3	Easily noticeable odor.
5	Maximum allowable conc., 8 hr.(23).
6-12	Immediate irritation of nose & throat(26), coughing(1).
20	Least amount causing eye irritation(26).
50-100	Maximum allowable conc., 1 hr.(26).
400-500	Immediately dangerous to life(26), immediate feeling of suffocation(19).
1,350	Median lethal concentration for mice (10-minute exposure).
10,000	(Not breathable) irritating to skin in a few minutes(26).

PLANT DAMAGE:

0.04 P.P.M. for 7 hours, injures most susceptible species.

TESTS:

M.S.A. Aspirator tester with SO_2 detecting tubes, starch iodate papers(16).

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* Analytical Chemistry, Vol. 29, pp. 1665-1666, November 1957.

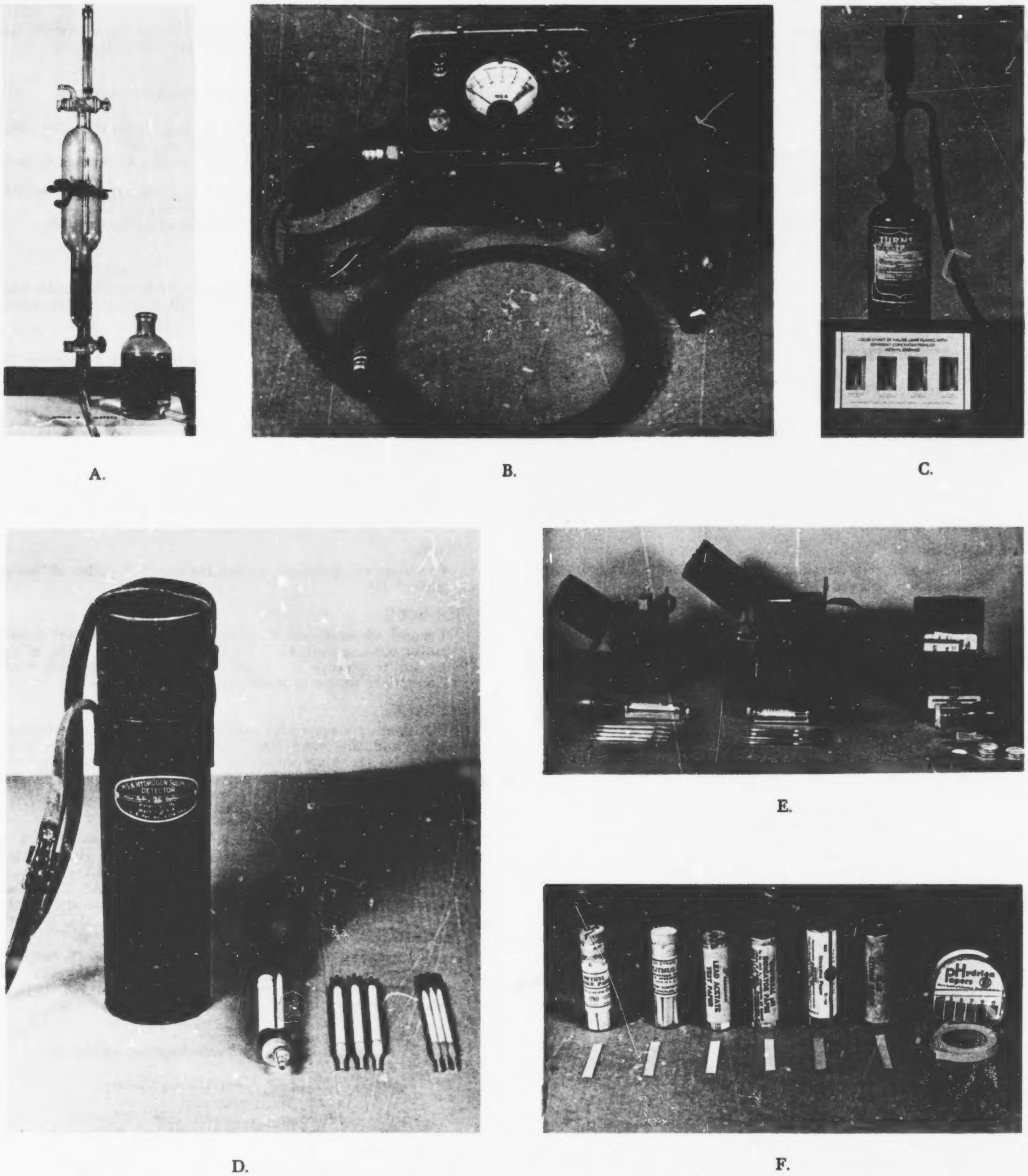
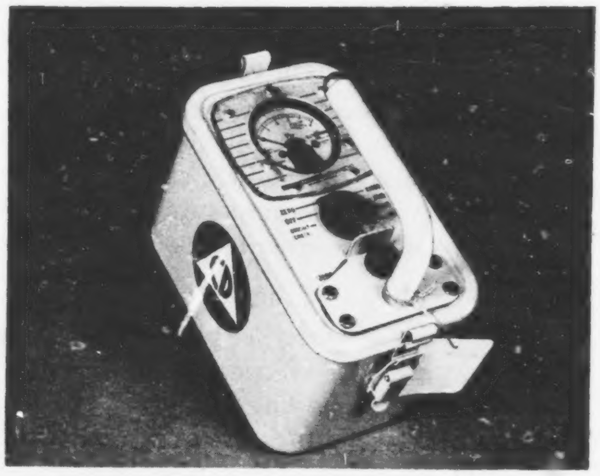


Figure XI - 10. Photographs of portable field-testing equipment: A—Tutweiler apparatus, B—explosimeter, C—halide leak detector, D—squeeze bulbs and ampules for H_2S testing, E—squeeze bulbs and ampules, from left to right: carbon monoxide, sulfur dioxide (also used for aromatic hydrocarbons and hydrogen cyanide), and hydrogen fluoride testers, F—test papers, G—Parsons Engineering particulate sampling device suitable for use in tracer studies, H—Fyrite CO_2 and O_2 analyzer, I—Ion chamber.

G.

H.



I.

III ON-THE-SPOT TESTING

A knowledge of the physiological response to contaminants is thus of use in making quick and sometimes crucial estimates of air pollution problems in any environment. While the inspector cannot make accurate determinations of concentration on the basis of sense perceptions only, he at least may be able to identify pollutants, allow for hazardous concentrations, and trace them to a logical source. In order to eliminate guesswork and to establish identity and concentration within a reasonable degree of accuracy some field sampling equipment is required. Such equipment, to be of use in enforcement, must be portable, require a minimum amount of equipment and field preparation, be of a direct-reading type, yet substantially accurate.

In the Enforcement Division of the APCD an on-the-spot-testing program is conducted by the Refinery Section which mans three especially equipped emergency test vehicles on a rotation basis. The use of these radio-equipped test vehicles extends considerably the District's ability to quickly identify and track down sources of air pollution which may be otherwise difficult to locate. A noxious or malodorous gas may originate from almost any point and spread over an entire community. A test car can be dispatched to the scene in a short time. The inspector manning the car is skilled in the use of the testing equipment and is prepared to test for the contaminant and trace it quickly to its source.

Noxious gases, odors, vapors and phenomena for which tests can be made in the field and which require no collection of samples for laboratory analysis are aldehydes, ammonia, aromatic hydrocarbons (benzene, toluene, styrene, xylene) atomic radiation, bee spots, carbon dioxide, carbon monoxide, chlorine, combustible gases and vapors, organic halides, humidity, hydrogen cyanide, hydrogen sulfide, mercaptans, oxygen (deficiency) and sulfur dioxide.

Operation of such equipment is beyond the scope of this manual. Instructional manuals are issued with the equipment on purchase. Here we shall point out the major types of such field equipment.

Testing equipment is added to test vehicles when proven to be reliable. The reagents and equipment used for testing as well as concentration ranges and thresholds are shown in Table XI-2. This equipment includes the following:

A. Test Papers

Certain types of simple sensitized papers will change color in the presence of physiologically significant concentrations of noxious gases, fumes or dusts. These can be used to test for or to verify the existence of certain suspected contaminants such as ammonia, hydrogen sulfide and phosgene. For example, ammonia reacts with litmus to produce a red to blue color change. Concentrations of ammonia from 0 to 1,000 ppm. can be detected by this method. Similarly, hydrogen sulfide may also be detected with lead acetate, phosgene with diphenylamine, etc.

B. *Squeeze Bulbs and Ampules*

These generally consist of two and three ounce squeeze bulb aspirators and glass tube ampules packed with impregnated granules. These granules stain, color or bleach in specific gas/solid reactions. The reagent in the granule surfaces gives colorimetric reactions when contaminated air is drawn through them. These are commercially available as the Mine Safety Appliance gas testers constructed for specific contaminants as shown in appropriate places in Table XI - 2.

C. *Tutweiler Apparatus*

This apparatus is used to determine concentrations above 150 p.p.m. of hydrogen sulfide, sulfur dioxide, ammonia and carbon dioxide in stack analyses, etc., by gas/liquid titrations. The apparatus consists of a 110 ml. burette serving as a gas/liquid reaction chamber with a leveling bottle; and a 10 ml. graduate mounted on top of the burette through a two-way cock. The third outlet of the cock, the gas inlet tube, is open to the atmosphere to be tested or connected by a tygon tube to the gas sample.

D. *Reich's Test*

This test is performed specifically to make volumetric determinations of SO_2 by gas/liquid titration. A metered amount of contaminated air is bubbled through a solution of water, iodine and starch in a graduated cylinder until a color change is observed. An amount of iodine equivalent to .2% of SO_2 in 1000 ml. of air is used in the solution, providing a calibration point.

E. *Midget Impingers and Gas Absorption Cells*

These are used for collecting particulate matter, aerosols and mists and are aspirated with a small 6" x 10" x 5" hand-operated pump, as in the case of the M.S.A. midget impinger. These employ the impingement principles described earlier in this chapter. The samples collected are analyzed in the field.

F. *Halide Leak Detector*

This equipment, based on Beilstein's reaction, is used for the determination of the concentration of halogenated hydrocarbon vapors such as freon, carbon tetrachloride, trichlorethylene and perchlorethylene. It consists of a small LPG fuel tank fitted with a microburner that has a copper ring reaction plate above the flame tip. A rubber tube sampling line feeds the contaminated air to the burner by natural draft. The flame color for a specific contaminant at an unknown concentration is compared with a color chart to estimate the concentration.

G. *Measurement of Volume Change*

These include principally the Fyrite CO_2 and O_2 analyzer shown in Table XI-2. Carbon dioxide is measured by the volume change resulting from absorption in caustic and oxygen by absorption in pyrogallic acid.

H. *Explosimeters or Combustion Meters*

These are used for testing combustible gases, i.e., carbon monoxide, natural gas, hydrocarbon vapors, similar to the explosimeters used by the gas companies. A three-foot metal tube probe is connected to the portable meter by a length of rubber tubing. The meter is operated on self-contained batteries and uses a two-ounce squeeze bulb to aspirate samples through the reaction chamber.

I. *Geiger Counters and Ion Chambers*

These are for use in radiological monitoring in the field in the event of disaster. A.P.C.D. personnel are given a sixteen-hour training course in the use of these instruments. All District vehicles are equipped with ion chambers since the A.P.C.D. has been designated by the Board of Supervisors as responsible for this phase of civil defense.

IV SAMPLING FUELS AND EFFLUENTS — FUEL AND EQUIPMENT REGULATION

Some categories of equipment, particularly those in refineries, produce predictable quantities of known "invisible" pollutants. For example, for each 1000 gallons of petroleum stocks stored in the open or in uncontrolled vessels some 100 pounds of organic vapors are lost to the atmosphere each day. When these petroleum products are stored or handled in large quantities, the loss may be considerable. Because the emission rate is relatively constant with product and temperature, the problem of "invisible" pollutants is readily solved by prescribing the use of control equipment which will reduce this loss to acceptable limits. In this instance, the storage of petroleum products is brought to acceptable limits either by the use of a floating roof or a vapor recovery system (Rule 56 below).

Regulations which prescribe equipment or fuel as a direct means of control symbolize a high degree of technological progress in the field of air pollution control, in that they are certain and directly enforceable, and are relatively unaffected by the human factor.

The APCD Rules of this type are as follows:

Rule 56 — Storage of petroleum products.
Rule 59 — Oil-effluent water separators.
Rule 61 — Gasoline loading.
Rule 62 — Sulfur content of fuel oil.
Rule 63 — Olefin content of gasoline.
Rule 64 — Rendering odors.

TABLE XI - 2.
CONTAMINANTS WHICH CAN BE TESTED IN THE FIELD WITH PORTABLE DEVICES*

CONTAMINANT	REASON FOR TESTING OR SOURCE TEST	REAGENT OR EQUIPMENT USED	TREATMENT OR REACTION OBSERVED	TIME REQUIRED a	b	c	CONCENTRATION RANGE OF TEST	EIGHT-HOUR[23] THRESHOLD LIMIT	SUFFICIENT WARNING WITHOUT TESTING
Aldehydes	Eye Irritation Complaints	Absorption in Sodium Bisulfite M.S.A. Midget Impinger	Iodometric Titration	10	5	10	0 - 1000 ppm	.5 to 5.0 ppm	Yes — Eye Irritation
Ammonia	Odor Complaints	Red Litmus & Stop Watch	Color Change to Blue	1	1	0	10 - 100 ppm	100 ppm	Yes — Odor
Aromatic Hydrocarbons		M.S.A. Aromatic Hydrocarbon Detector	Colors. Treated Granules. Stain Length Measured						
1. Benzene	Odor Complaints	" "		10	2	0	0 - 100 ppm	25 ppm	Yes — Odor
2. Toluene	" "	" "	" "	10	2	0	0 - 400 ppm	200 ppm	Yes — Odor
3. Xylene	" "	" "	" "	10	2	0	0 - 400 ppm	200 ppm	Yes — Odor
4. Styrene	" "	" "	" "	10	2	0	Qualitative	100 ppm	Yes — Odor
Arsine	Odor Complaints Plating Operations	M.S.A. Arsine Detector	Treated Filter Papers Change Color	10	2	1	0 - 100 ppm	0.05 ppm	No
Carbon Dioxide	Exhaust Complaints	Fyrite CO_2 Analyzer	Absorption in Caustic & Measure Vol. Change	1	3	0	0 - 20%	5000 ppm	No
Carbon Monoxide	Exhaust Complaints	M.S.A. CO Detector	Colors. Treated Granules — Color Change	1	2	2	0 - 1000 ppm	100 ppm	No
Chlorine	Cylinder Loading & Bleach Mfg.	O-Tolidine in the M.S.A. Midget Impinger	Color Intensity Compared to Standards	10	5	2	0 - 70 ppm	1 ppm	Yes — Odor for Immediately Dangerous Levels. No — for Low Conc.
Combustible Gases	Venting Storage Tanks Odor Complaints Rule 56 and Rule 59	M.S.A. Model 40 Combustible Gas Indicator	Direct Reading Instrument	1	2	2	0 - 20 x LEL	—	Some Yes — Odor
Hydrocyanic Acid Gas	Plating Processes	M.S.A. Hydrocyanic Acid Gas Detector	Treated Granules Orange Color	10	2	0	0 - 50 ppm	10 ppm	Yes — Odor — by Trained Personnel
Hydrogen Fluoride	Phosphate Rock	M.S.A. Hydrocyanic Fluoride-in-air Detector	Treated Filter Papers Change Color	5	5	0	.5 - 5 ppm	3 ppm	Yes — Odor for Immediately Dangerous Levels. No — for Low Conc.
Hydrogen Sulfide	Odor Complaints Refineries and Chemical Processes	M.S.A. H_2S Detector	Treated Granules Change Color	1	2	0	0 - 50 ppm	20 ppm	No — Odor Is not Reliable
Nitrogen Dioxide	Atmospheric	Saltzman Reagent	Color Change Measured	1	1	d	0 - 10 ppm	5 ppm	Not Reliable
Ozone	Safety Level from Air Purifiers	Rubber Cracking	Time Interval of Cracking Measured	10	20	2	0 - 100 ppm	10 pphm	No
Oxygen Deficiency	Closed Vessels or Room	Fyrite Oxygen Analyzer	Absorption Measure Volume Change	5	5	0	0 - 21%	18 - 21%	No
Phosgene	Thermal Decomposition of Organic Halides	Treated Filter Papers	Color Change Compared to Standards	5	5	1	1 - 100 ppm	1 ppm	No
Phosphine	Mfg. of Acetylene	Treated Granules	Color Stain Length Measured	5	5	2	1 - 10 ppm	5 pphm	No
Sulfur Dioxide	Complaints	M.S.A. SO_2 Detector Treated Granules	Length of Bleaching Action Measured	10	2	0	1 - 150 ppm	5 ppm	Yes — Odor
	Rule 53a	Reich's Test	Gas Titration	10	10	5	.20%		
	Rule 62	Tutweiler	Gas Titration	10	10	5	50 Grains/ft³		

a. Preparation in minutes
b. Test or Sampling
c. Calculation and Interpretation
d. Laboratory Analysis

* Prepared by
Maurice Fykes
Senior Engineering Inspector

In most instances, the enforcement of these rules will involve sampling of fuels or materials before emission to the atmosphere, and checking maintenance and operation of equipment.

A. Rule 56 —*Storage of Petroleum Products.*

Rule 56 requires that any tank or reservoir of more than 40,000 gallons capacity storing petroleum products of a vapor pressure of 1.5 pounds per square inch absolute or greater under actual storage conditions must use either a floating roof type of vapor control adequately secured against leaks, provided that the vapor pressure does not exceed 11.0 pounds per square inch absolute or greater under actual storage conditions; or a vapor recovery and vapor disposal system which prevents the emissions of hydrocarbon vapors and gases to the atmosphere, or other equipment of equal efficiency.

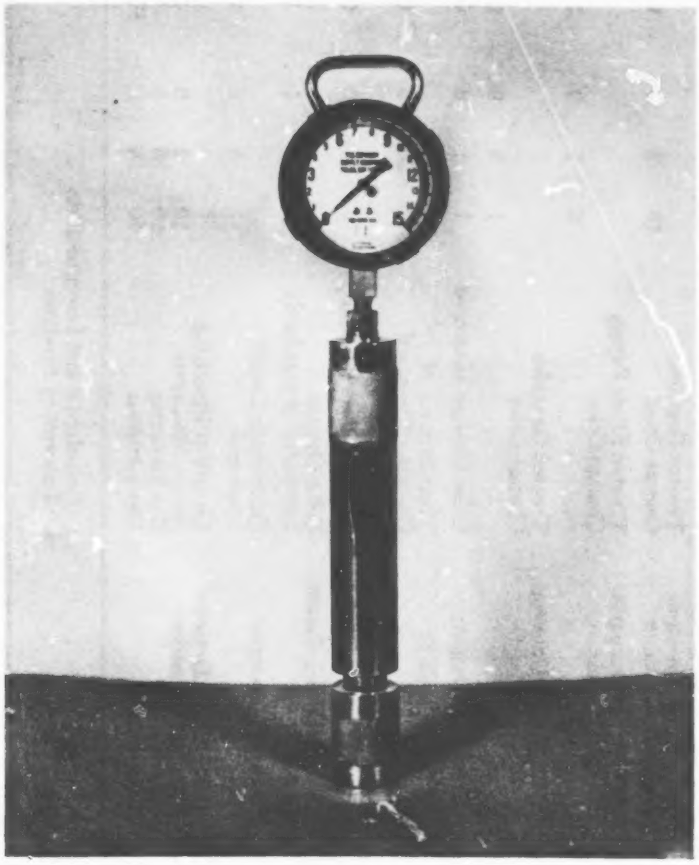


Figure XI - 11. Reid vapor pressure bomb and gauge.

The important check points in determining compliance are the vapor pressure, the efficiency of the control device and the quality of operating and maintenance practices. A vapor loss can be detected by the hissing sound of gas under high pressure, by refraction of light (which casts shadows), or by condensation of the moisture from the air with subsequent formation of frost on the leaking valve which has been cooled by the sudden expansion of the escaping gas.

The vapor pressure of a liquid is that pressure exerted by the molecules of the liquid to change from the liquid to the vapor state. If the vapor pressure is below that of the pressure of the atmosphere, the molecules will remain in the liquid state. However, by increasing the temperature of the liquid, the vapor pressure begins to increase rapidly. When the vapor pressure exceeds the atmospheric pressure, the substance vaporizes. The boiling points of substances indicate, as a matter of fact, the points at which they vaporize. Substances of high vapor pressure thus volatilize at lower temperatures than substances of low vapor pressure.

Vapor pressure is measured in pounds per square inch absolute at actual storage conditions. Reid vapor pressure is a measurement taken in the petroleum industry by means of an A.S.T.M. Reid Vapor Pressure Bomb and Gauge (Figure XI-11). The Reid measurement is made by carefully sampling the liquid in a bomb and by immersing it in a water bath,temperature at 100°F. The vapor pressure is thus rated at this elevated temperature. The Reid vapor pressure is usually about 5 to 9 per cent lower than the absolute pressure, although this relationship will vary widely (see Figure XI-12). A grab-sample of the product can be taken by the inspector in a 1 qt. or 2 qt. tin which is sealed tight and refrigerated as soon as possible when brought to the laboratory.

Petroleum products with vapor pressures greater than 1.5 lbs. per square inch absolute consist generally of cracked petroleum stocks and distillates such as gasoline, aviation gasoline, propane or butane (L.P.G.), some jet fuels, and some solvents and naphthas. In questionable cases a Reid vapor pressure test may be taken at the refinery with refinery facilities, or a sample taken to the APCD Laboratory. If one is taken, the storage temperature should be recorded.

The inspector also checks the equipment for leaks, maintenance of gas-tight seals on floating roof tanks, or degree of malfunctioning of vapor recovery systems.

B. Rule 59 — *Oil-Effluent Water Separator*

Rule 59 in essence states that no compartment of a single or multiple compartment oil-effluent water separator which receives effluent water containing 200 gallons a day or more of any petroleum product from any equipment processing, refining, treating, storing or handling kerosine* or other petroleum product of equal or greater volatility, can be used unless such compartment is equipped with one of the following vapor loss control devices:

a. A cover totally enclosing the liquid contents or
b. A floating roof pontoon or double-deck type or
c. A vapor recovery system or
d. Other equipment of equal efficiency approved by the APCD.

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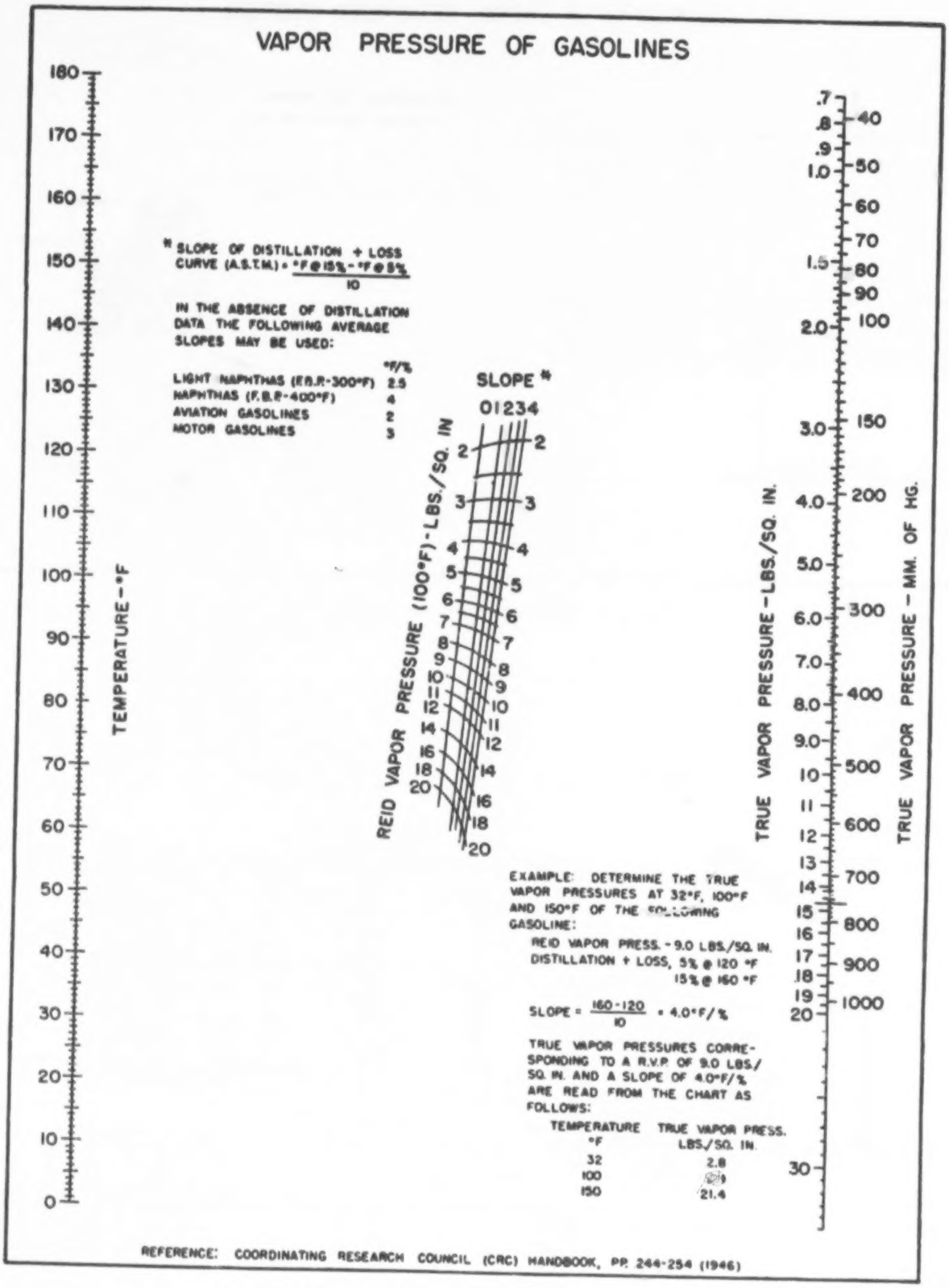
* Rule 59 defines "kerosine" as "any petroleum product which. when distilled by ASTM standard test Method D86-56, will give a temperature of 401°F. or less at the 10 per cent point recovered".



VAPOR PRESSURE OF GASOLINES

* SLOPE OF DISTILLATION + LOSS CURVE (A.S.T.M.) = $\frac{°F @ 15\% - °F @ 5\%}{10}$

IN THE ABSENCE OF DISTILLATION DATA THE FOLLOWING AVERAGE SLOPES MAY BE USED:

	°F/%
LIGHT NAPHTHAS (F.B.P.-300°F)	2.5
NAPHTHAS (F.B.P.-400°F)	4
AVIATION GASOLINES	2
MOTOR GASOLINES	3

EXAMPLE: DETERMINE THE TRUE VAPOR PRESSURES AT 32°F, 100°F AND 150°F OF THE FOLLOWING GASOLINE:

REID VAPOR PRESS. – 9.0 LBS./SQ. IN.
DISTILLATION + LOSS, 5% @ 120 °F
15% @ 160 °F

SLOPE = $\frac{160 - 120}{10}$ = 4.0°F/%

TRUE VAPOR PRESSURES CORRESPONDING TO A R.V.P. OF 9.0 LBS/SQ. IN. AND A SLOPE OF 4.0°F/% ARE READ FROM THE CHART AS FOLLOWS:

TEMPERATURE °F	TRUE VAPOR PRESS. LBS./SQ. IN.
32	2.8
100	[illegible]
150	21.4

REFERENCE: COORDINATING RESEARCH COUNCIL (CRC) HANDBOOK, PP. 244-254 (1946)

Figure XI - 12. Scales for converting Reid and true vapor pressures.

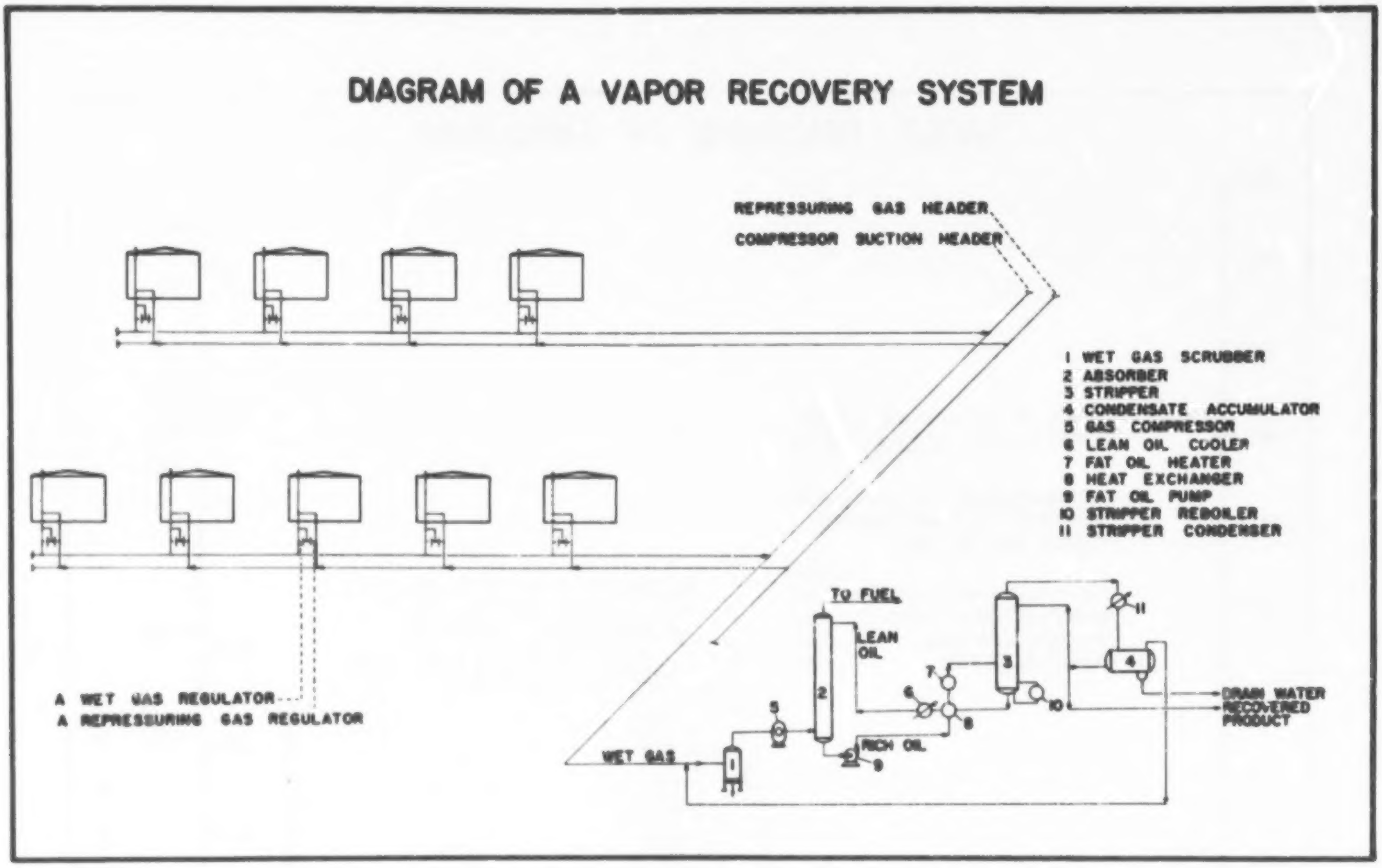


Figure XI - 13. Diagram of a vapor recovery system.

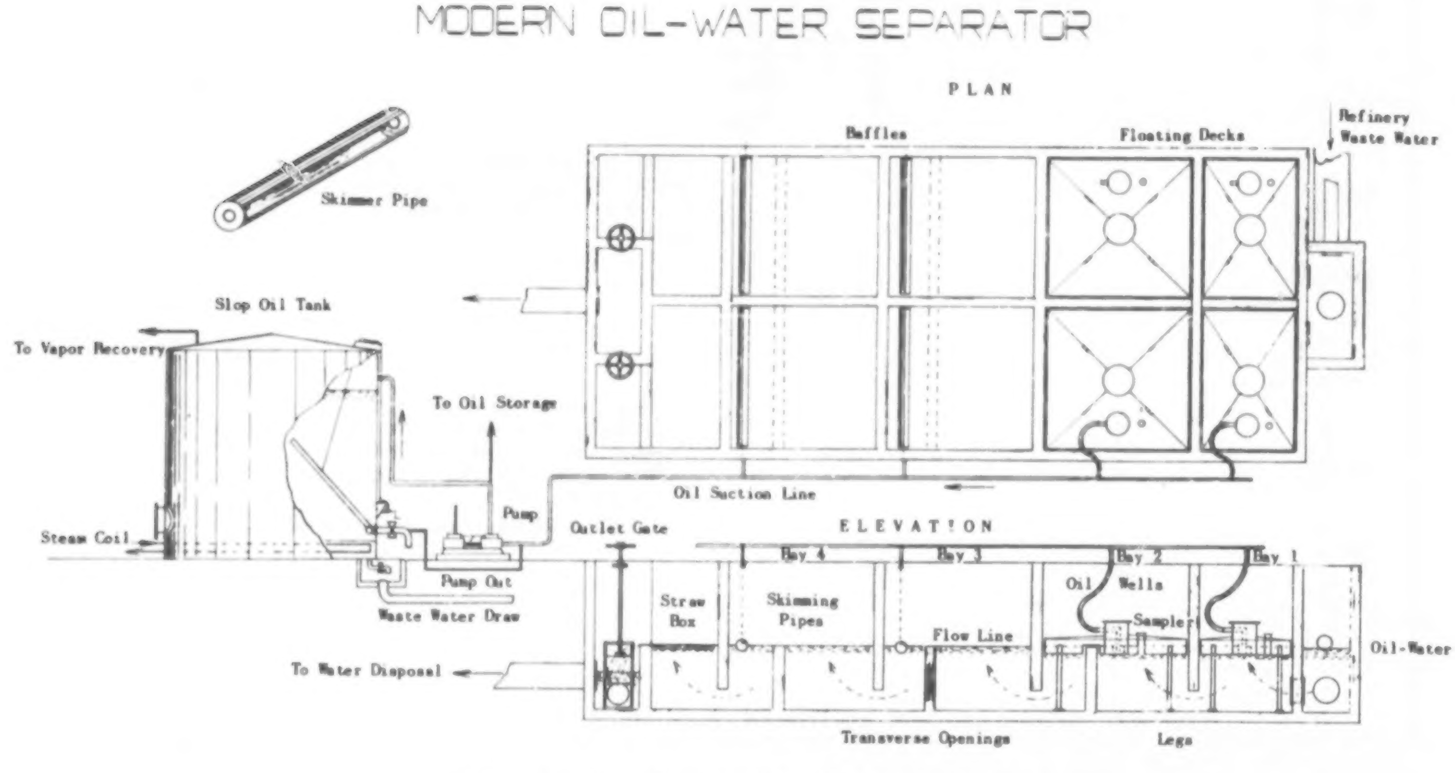


Figure XI - 14. Diagram of an oil-water separator.

This does not apply to any separator used exclusively in conjunction with the production of crude oil.

Petroleum products generally affected by this rule are kerosine and other products of equal or greater volatility such as jet fuels, paint thinner, cleaner and naphtha (Stoddard solvent), the various grades of gasoline and possibly some Liquefied Petroleum Gas (L.P.G.). Processes affected by this rule are generally related to absorption, thermal and catalytic cracking, crude distillation, laboratory areas, barrel cleaning (light oil), alkylation, polymerization, kerosine and lighter oil treating, light oil redistillation, gasoline stabilization, and tanks and shipping points connected with the above.

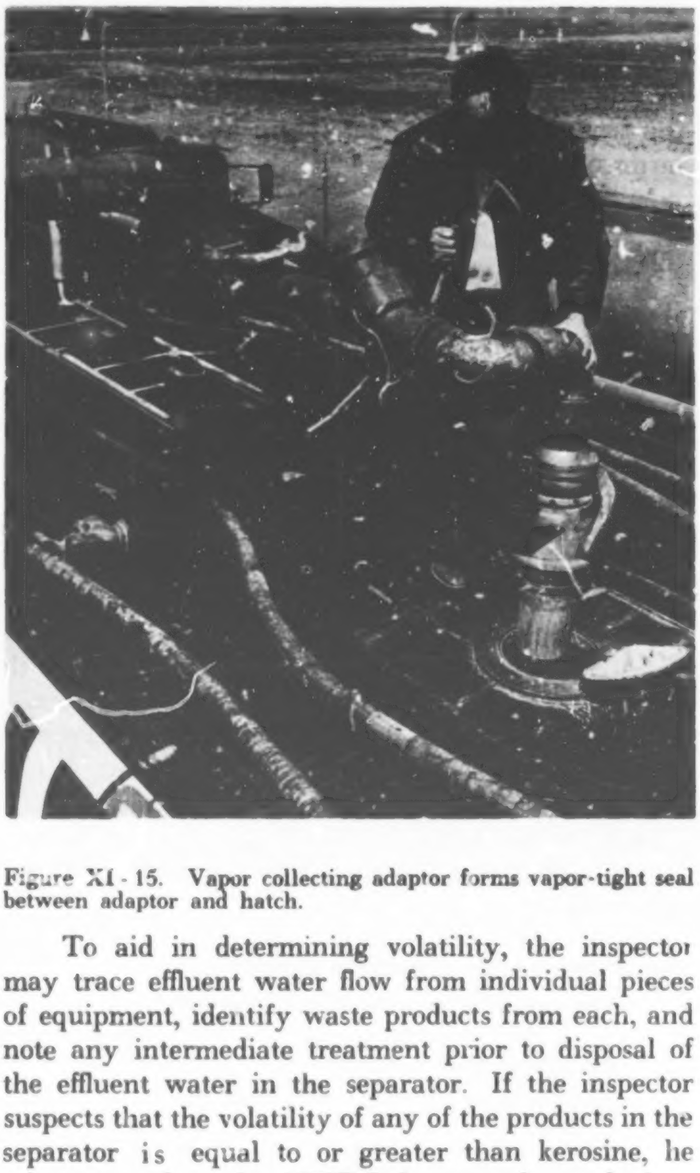


Figure XI - 15. Vapor collecting adaptor forms vapor-tight seal between adaptor and hatch.

To aid in determining volatility, the inspector may trace effluent water flow from individual pieces of equipment, identify waste products from each, and note any intermediate treatment prior to disposal of the effluent water in the separator. If the inspector suspects that the volatility of any of the products in the separator is equal to or greater than kerosine, he takes a sample to the APCD Laboratory for analysis.

C. Rule 61 — *Gasoline Loading into Tank Trucks and Trailers*

Rule 61, in essence, states that any loading facility on any premises where more than 20,000 gallons of gasoline are loaded in one day into any tank truck or trailer must be equipped with a vapor collection and disposal system.

If loading is effected through the hatches of a tank truck or trailer, the loading arm must be equipped with a vapor collecting adaptor so as to force a vapor-tight seal between the adaptor and the hatch.

If loading is effected through other means, all loading and vapor lines should be equipped with fittings which make vapor-tight connections and which close automatically when disconnected.

For the purpose of Rule 61, any petroleum distillate having a Reid vapor pressure of four pounds or greater is included by the term "gasoline".

To ascertain compliance with Rule 61, the inspector must identify the product loaded. All racks on premises loading gasoline or petroleum distillates having a Reid vapor pressure of four pounds or greater, such as Liquefied Petroleum Gas (L.P.G.), some naphthas, some jet fuels and some solvents, are affected by this Rule. In doubtful cases, samples should be brought to the laboratory for analysis.

The quantity of gasoline or petroleum distillates loaded each day should be determined. The company files can be checked for the total quantity in gallons of petroleum distillates loaded from each rack for any one day. If there is more than one rack on the premises, the gallons loaded from all racks is taken as a daily total. If a premises load more than 20,000 gallons in any one day, it is affected by this rule.

The inspector inspects the presence and operation of the controls in the following manner:

1. Check all fittings for vapor-tight connections. Note whether they close automatically when disconnected.
2. Check for vapor-tight seals between adaptors and hatches.
3. Check whether drainage from the loading device is prevented when it is removed from the hatch of the tank or trailer.
4. Check efficiency of control of vapor collection and disposal system.

D. Rule 62 — *Sulfur Content of Fuels*

Rule 62 is quoted here in full.

> RULE 62. SULFUR CONTENT OF FUELS. A person shall not burn within the Los Angeles Basin at any time between May 1 and September 30, both dates inclusive, during the calendar year 1959, and each year thereafter between April 15 and November 15, both inclusive, of the same calendar year, *any gaseous fuel containing sulfur compounds in excess of 50 grains per 100 cubic feet of gaseous fuel, calculated as hydrogen sulfide at standard conditions, or any liquid fuel or solid fuel having a sulfur content in excess of 0.5 per cent by weight*.

The provisions of this rule shall not apply to:

> a. The burning of sulfur, hydrogen sulfide, acid sludge or other sulfur compounds in the manufacturing of sulfur or sulfur compounds.
>
> b. *The incinerating of waste gases provided that the gross heating value of such gases is less than 300 British thermal units per cubic foot at standard conditions and the*

fuel used to incinerate such waste gases does not contain sulfur or sulfur compounds in excess of the amount specified in this rule.

c. The use of solid fuels in any metallurgical process.

d. The use of fuels where the gaseous products of combustion are used as raw materials for other processes.

e. The use of liquid or solid fuel to propel or test any vehicle, aircraft, missile, locomotive, boat or ship.

f. The use of liquid fuel whenever the supply of gaseous fuel, the burning of which is permitted by this rule, is not physically available to the user due to accident, act of God, act of war, act of public enemy, or failure of the supplier.

1. Gaseous Fuel

To determine compliance with Rule 62 of gaseous fuels two separate tests are required: (1) determination of heat value (Btu) and (2) determination of sulfur loading.

These tests need not be performed on fuel lines containing commercially available natural gas only, since natural gas meets the specifications of Rule 62.

Two types of refinery gas fuels will, however, require the inspector's attention. These are: (1) refinery "make" gas derived from light ends from processes and sweetened or diluted in mixing drums, and (2) refinery waste gases generally arising from tail gases from H_2S absorption and waste water stripping systems, or any gas which is not diluted and sweetened.

"Make" gas in refinery fuel distribution systems generally has a heat value in excess of 300 Btu as specified in the Rule and need only be tested for an excess of 50 grains as described below. "Make" gas usually complies with Rule 62 due to dilution with natural gas. However, sulfur loading tests are conducted routinely, and especially upon observance of a visible plume.

The waste gas, on the other hand, should be tested for heat value and sulfur loading. The pressure gauge is removed from the waste gas line and a probe connected to a combustible gas indicator is inserted for testing of heat value. The combustible gas indicator acts as a thermocouple that has been previously calibrated for on-scale readings by use of a proper size dilution orifice (see Figure XI-16).

If the gross heating value exceeds 300 Btu/ft^3, then the sulfur loading must be determined. The testing is accomplished in the field by applying an MSA H_2S tester which gives colorimetric reactions. The H_2S tester (Figure XI-10D) is applied at the pressure gauge of the waste gas line by means of a nipple, adaptor and a T-joint whenever the waste gas fuel line is under greater than atmospheric pressure (see Figure XI-7). The sulfur loading of this gas is determined by measuring the length of the stain on the impregnated granules. If the reading is in excess of 25 grains with 5 squeezes of the bulb, an excess of 50 grains is indicated. A sample should be taken to the laboratory to determine actual grain loading so that the necessary enforcement action can be taken.

Waste gases under less than atmospheric pressure, usually those originating from sour water stripping operations and introduced into combustion zones by jet or steam injection, must be sampled in an evacuated gas sample bottle adequately equipped with stop cocks applied to the line by means of a straight adaptor. The sample is then brought to the laboratory for analysis (see Figure XI-8).

2. Liquid or Solid Fuels.

To determine compliance with Rule 62 of solid or liquid fuels an adequate sample must be collected from the fuel line and taken to the laboratory for analysis to determine sulfur loading of the fuel.

Assuming* that equipment is in good order and is being operated correctly, a visible emission is a good indication that this rule is being violated. A sample of the fuel should then be taken.

Excessive sulfur content in liquid or solid fuels may be suspected, also, by the known specifications of the fuel being used. Fuel specifications are given in terms of:

Grade
Description
Bunker No.
API Gravity
Specific Gravity °Be[1]
Btu/lb.
Dens. lb/Gal.
Specific Gravity

Whenever a value given for any of these fuel specifications correlates closely with .5 per cent sulfur by weight, a sample should be taken. It should be cautioned, however, that sulfur content varies considerably within any specification category, depending on the geographical source of the crude. The specific sulfur content should be ascertained from purchase receipts or through inquiry.

If the inspector cannot through interview of the operator or examination of fuel oil receipts determine the API gravity, he ascertains some other fuel specification which he correlates with sulfur content. If he is in doubt and cannot acquire any specifications, he should take a sample.

Fuel oil samples should be collected in 1 or 2 quart tins.

E. Rule 63 — *Gasoline Specifications*

RULE 63. GASOLINE SPECIFICATIONS:

a. A person shall not, after June 30, 1960, sell or supply for use within the District as a fuel for motor vehicles as defined by the Vehicle Code of the State of California, gasoline having a degree of unsaturation greater than that indicated by a Bromine Number of 30 as determined by ASTM method D1159-57T modified by omission of the mercuric chloride catalyst.

b. A person shall not, after June 30, 1962, sell or supply for use within the District as a fuel for motor vehicles as defined by the Vehicle Code of the State of California, gasoline having a degree of unsaturation greater than that indicated by a Bromine Number of 20 as determined by ASTM method D1159-57T modified by omission of the mercuric chloride catalyst.

c. For the purpose of this rule, the term "gasoline" means any petroleum distillate having a Reid vapor pressure of more than four pounds.

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* **Emphasis supplied — ed.**

Figure XI - 16. Measuring gross heating value on a refinery waste-gas line with a combustible gas indicator.

Figure XI - 17. Application of H_2S Tester to the waste-gas line.

Figure XI - 18. Application of an evacuated gas sample bottle to the waste-gas line under negative pressure.

Compliance with Rule 63 must be determined by laboratory analysis of sample taken at retail pumps. The bromine number is the number of grams of bromine consumed by 100 g. of the sample when reacted under given conditions. The sample is dissolved in a specific solvent and titrated with bromide-bromate solution at 0 to 5°C. The end point is indicated by a dead stop electrometric apparatus.

The bromine number is approximately 60% of the olefin content. A bromine number of 20 is approximately equivalent to an olefin content of 12½%, that of 30 to 18%, etc. (ASTM, *ASTM Standards*, 1957 Supplement, Part 5, 1968, p. 81).

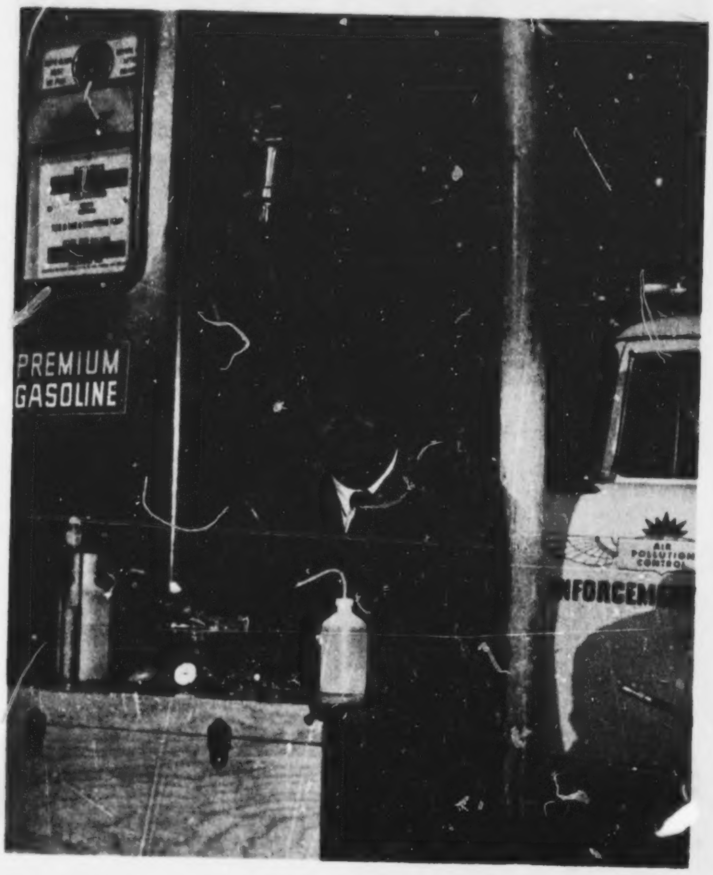

Figure XI - 19. Equipment used in determining excessive bromine values of gasolines in the field.

To avoid costly and time consuming laboratory analyses of all field samples collected, a modification of the ASTM method has been devised by Fykes, Clawson and Kuramoto for direct field testing(28). This modification does not give the bromine number of each sample, but quickly indicates whether the sample is above or below a bromine number of 30. By changing reagent quantities this test can also be made to indicate bromine number values above or below 20 etc. Only those samples which then indicate an excessive bromine value are brought to the laboratory for detailed testing. The procedure employed is quoted from Fykes *et al* below.

This simple test consists of adding a measured sample of the gasoline to be tested to a measured volume of reagent (see procedure below), followed by the addition of a solvent and agitating the mixture for 30 seconds. If the resulting mixture shows a yellow color, from a faint tinge to strong yellow, the gasoline is below 30 bromine number. (The yellow color is due to unreacted bromine). If the reaction mixture is water "white" the gasoline is above a bromine number of 30. Gasolines which "fail" this test can be sent to the laboratory for more precise analysis. Dyes used in some gasolines need not confuse the operator. All color is bleached out by the free bromine liberated during the test reaction.

The equipment needed for each testing "kit" is as follows:

EQUIPMENT	QUANTITY
Flask, Ehrlenmeyer, 125 ml.	1
Polyethylene washing bottle, 500 ml.	1
beaker, 100 ml.	1
pipette, 1 ml.	1
Graduated pipette, 10 ml.	1
Stock bottle for reagent, 3 ounce	1
Stock bottle for solvent, 1 quart	1

CHEMICALS

Reagent: Dissolve 51.0g KBr and 13.92g $KBrO_3$ in distilled water and fill to 1 liter

Solvent: 714 ml. glacial acetic acid
134 ml. carbon tetrachloride
134 ml. methyl alcohol
18 ml. sulfuric acid (one to five)

GASOLINE SAMPLING PROCEDURE

Sampling container: 4 oz. can with screw cap

1. Fill container with fresh gasoline.
2. Cap immediately and use for field test.
3. Return sample to station operator if it passes or deliver to the laboratory at headquarters as soon as possible if it fails field test.

TEST PROCEDURE

1. Pipette 5.5 ml. of reagent into the Ehrlenmeyer *flask*, with the 10 ml. pipette.
2. Pour 50 ml. of solvent into the beaker (fill to mark).
3. Pipette exactly 1.0 ml. of the gasoline to be tested into the reagent in the Ehrlenmeyer flask, with the 1.0 ml. pipette.
4. Quickly add the solvent from the beaker to the mixture in the flask. (The acid in the solvent liberates bromine from the reagent.) Agitate (swirl) mixture in flask for 30 seconds.
5. Read result.

(CAUTIONS: (1) Blow out the last drops of reagent and gasoline sample remaining in the pipette tip after free flow has ceased. (2) In pipetting take care to avoid drawing materials into the mouth.)

CLEANUP

Rinse the Ehrlenmeyer flask with tap water and drain; then rinse it twice more with a small quantity of distilled water after each test. *Blow through 1 ml. pipette after each test.*

The beaker and 10 ml. pipette need not be cleaned between tests at any one location. After finishing tests at any one location rinse beaker and 10 ml. pipette in same manner as flask.

DISCUSSION

Field and Laboratory Appraisal.

The results from more than 150 tests using the field method in the laboratory and in the field agree with results obtained by ASTM D1159-59T (electrometric titration).

This method uses an arbitrary visual end point. No temperature control is used.

1. *Catalyst*. To establish the effect of a catalyst in this test, a series of samples were tested with and without the use of the catalyst $HgCl_2$. The results from the two were identical.
2. *Temperature*. All tests were made at ambient temperatures. The increase in temperature upon the addition of the bromide-bromate solution was found to be approximately 1°C.
3. *Visual End Point*. The retention of some degree of yellow color, due to the presence of unreacted free bromine, for thirty seconds is the arbitrary limit set for samples passing the test. Samples turning water clear in less than thirty seconds fail this test. All dyes encountered so far are immediately decolorized by the free bromine. The following variations in color and clearing time were noted from synthetic samples of hexene—2 and N—heptane but no attempt will be made to calibrate these phenomena:

BROMINE NUMBER	PHENOMENA
2-20	dark yellow-orange
24-26	medium yellow
26-29	light yellow
30	colorless after 30 secs.
31.3	colorless after 5 secs.
34-35	colorless after 3 secs.
40-50	colorless after 2 secs.
50-64	colorless instantly

After Color. Some reaction mixtures on standing for several minutes (1-3 with catalyst; 3-5 without catalyst) develop a pink or orchid color. This color bears no relation to the test results.

4. *Critical Point*. This test is critical for samples with a bromine number of thirty. By not blowing out the last drop of bromide-bromate solution from the pipette the sample under test retains its color only fifteen seconds, thereby failing the test. The proper blowing out of the last drop causes the yellow color to be retained in excess of thirty seconds. By not blowing out the last drop of the gasoline sample, borderline (30-31) bromine numbers pass this test.

5. *Reagent Stability*. Work to this time, including the routine gasoline analyses indicates that the bromide-bromate reagent is quite stable, and possibly much more so than the standard olefin composed of hexene-2 and heptane. If the higher temperatures of summer field work tend to make the reagent less stable they would also tend to change the composition of the standard olefin, which must be exposed to air at each use. An example of the stability of the Br^-, BrO_3^- solution under laboratory storage conditions is:

   > One solution varied only 0.0002 normality after storage for one month (standardized at 0.5027N, and a month later, at 0.5029N). Errors of much greater magnitude (0.02±) are inherent in the necessary assumption of 0.73 for the density of the gasoline samples. The reagent is described as stable in Scott's Standard Methods of Chemical Analysis.

6. *Low Actinic Glassware*. Low actinic glassware is used for storage of bromide-bromate solution and the titration solvent.

7. *Four-oz. Sample Cans*. A four-fluid-ounce sample is a sufficient quantity for this test. The problems of cost of the gasoline (less than 1c in most cases) and confiscation (32 samples are needed to make a full gallon) are avoided. The cans cost approximately 10c each.

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CHAPTER TWELVE

TRACKING SOURCES OF PUBLIC NUISANCES: ODORS, STAINS AND DEPOSITS

I THE PUBLIC NUISANCE PROBLEM

Up until now control standards have been treated in terms of proscribing exact concentrations, effluent loadings, or opacities of air contaminants, thus providing an unequivocal basis for legal action. A type of air pollution problem shall now be dealt with, which is characterized by an adverse effect of a certain but unpredictable quantity of a contaminant on the health, welfare or comfort of a significant community of persons. The effect may be an odor sensation caused by the emanation of malodorous gases and vapors; stains on surfaces of property resulting from impaction or deposition of liquid particles, usually of an acidic nature; nuisance deposits generally arising from dusts or fly ash; or toxicity or plant damage arising from the presence of toxic contaminants.

The public nuisance is typically an urban problem. Incidents of nuisance thus increase with population and chaotic growth patterns, especially when industrial plants encroach upon residential areas and vice versa. The more compact mixed industrial-residential communities, the smaller the concentrations and quantities of contaminants necessary to create a public nuisance.

The public nuisance is always first manifest by a reaction on the part of a segment of the public. The air pollution configuration here must be worked backwards from effect to cause, i.e., the contaminant or contaminants causing the nuisance must be tracked from the complainant to the source by the field inspector. Sometimes the source of the nuisance may be obviously known to the community, or, as in many cases, it may be completely unknown. In some cases multiple sources may exist, or an entire industrial community may contribute to a nuisance. In still other cases, sources may be situated at remote distances from complainants.

As an enforcement tool, the public nuisance statute is awkward to apply, if not frequently ineffective altogether, for three important reasons(7):

1. *Lack of Definite Emission Standards.* Public nuisance rulings do not involve emission standards which are as definite as maximum permissible emission standards. Because small quantities of pollutants create odors or nuisance deposits in some situations and not in others, no prohibitory emission level can be logically established. The principle difficulty here involves incomplete knowledge concerning the range of human attitudes towards nuisances. It is conceivable that further knowledge regarding susceptibility and air quality will increase and that standards will inevitably be applied which will eliminate most, if not all nuisances. For the present, we can only restrict and control specific practices which are known to emit nuisance contaminants.
2. *Difficulty of Relating Source, Contaminant and Nuisance.* Proof must be shown of the nuisance value of a contaminant or class of contaminants, as distinguished from other possible contaminants, and that the contaminant originates from a specific piece of equipment at an address-location, even though many plants may be found in the vicinity capable of emitting the same type of contaminant. Thus, rigorous tracking techniques and proof may be required. The evidence necessary may be difficult, if not impossible to obtain in some situations.
3. *Unreliability of Testimony from a Considerable Number of Persons.* This is the greatest weakness of the public nuisance case. Even though all complainants may agree that a nuisance exists, considerable disagreement as to quality, severity, time of occurrence of the nuisance, etc., usually arises. Testimony must withstand rigorous cross-examination by a defense attorney and sustain a judicial finding that annoyance, discomfort or injury occurred, all nebulous terms in the eyes of jurists.

For these reasons, the enforcement agency may employ means to solve a nuisance without enforcing the nuisance statute. It may (1) apply some other rule or law which will accomplish the same result, (2) motivate voluntary correction on the part of management, or (3) promulgate corrective legislation to establish new *per se* standards for specific contaminants, equipment or fuel regulation.

With regard to (1) above, various other regulations can be enforced in public nuisance cases, such as those employed by the A.P.C.D. below:

> Section 24279. PERMITS. This law, in effect, requires plants to secure permits prior to installing or operating equipment. If, after scrutiny, equipment causing nuisances do not have valid operating permits, they can be eliminated through the permit system.
>
> Section 24280. PERMIT CONDITIONS. All equipment is required to meet exacting standards before an operating permit or authority to construct is issued. Permits can be strictly conditioned in regard to operational and maintenance procedures. Operation of equipment contrary to the conditions of the permit is, therefore, a violation.
>
> REVOCATION PROCEEDINGS. Old unconditioned permits granted by virtue of Rule 13 can be revoked through hearing board procedures if violations or nuisances are observed. New permits issued under improved operating conditions can be applied for by management. These then may be severely conditioned. This procedure, however, is not as effective as taking nuisance cases to court.

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Rule 19. SAMPLING FACILITIES. This rule requires that plant operators erect and maintain appropriate sampling facilities. This rule enables inspectors and testing personnel to sample discharges from stacks to determine more exact compliance with maximum permissible emission standards, or to more thoroughly evaluate nuisance contaminants.

OTHER LAWS. Any other laws involving visible or invisible air contaminants are automatically enforced.

The promulgation of new specific legislation (i.e., maximum permissible emission, fuel or equipment regulation) generally follows engineering or technical solutions to air pollution problems. Contaminants which were previously public nuisances only in fact become nuisances *per se* by the passage of rules with definite contaminant standards. For example, such District Rules as 52, 53, 54 and particularly 57, 58, 62 and 64 automatically eliminate a multitude of incidents which previously created public nuisances. In an active control program new rules incorporating specific standards tend to obviate the use of the public nuisance statute.

Problems which cannot be solved by specific contaminant, equipment or fuel regulations must still be treated as public nuisances, however. Especially is this true in the case of the odor nuisance. Various means of measuring odor quality and intensity have been developed by means of odor surveys (organoleptic methods) and vapor dilution but these are still inadequate for development of odor standards for legislation comparable to the smoke standard. In the absence of such standards, odor cases must still be generally handled as public nuisances.

A public nuisance, then, in any active control program, is a problem for which there is no standard solution. Solutions are encouraged through enforcement action. Once a legal nuisance is established, the plant operator will either be required to abandon the specific nuisance-causing operation, or develop remedial or alternative methods of operation.

A. Tracking the Nuisance

In a routine inspection of an industrial plant, the inspector traces the normal air pollution configuration, as described in Chapter 9, from cause to effect — from the feed input of equipment to the effects of the contaminant generated from the equipment on receptors and the environment. The tracing of an air pollution problem reported as a public nuisance is just the reverse of this procedure. The investigation begins with the complainant and his environment and works back to the equipment responsible in the following steps:

1. Interview of complainants to obtain as much factual information as to the intensity, evidence and source of the contaminant. (See Chapter 8).
2. Identification of the contaminant causing the nuisance.
3. Tracking the contaminant to its source or sources.
4. Inspection of the equipment at the source to determine plant's capacity to emit the contaminant.
5. Collecting signed district attorney forms from complainants who desire to testify in court.
6. Serving notices of violation to the source, or motivating plant management to remedy the situation.

Most of these techniques are described in appropriate sections of this manual. This chapter is primarily concerned with the problem of tracking and identifying sources of public nuisances, assuming that the source is not immediately determined.

In a public nuisance, the field inspector must establish the existence of two areas: the effect area, that is, the geographical boundaries containing the complainants, in addition to the area over which the nuisance effect is widespread; and the source area — that area which can be assumed by logical tracking techniques to contain the specific source or sources of the nuisance contaminant. The determination of a source area is often a first step in isolating the exact source and cause of the nuisance, especially in those cases where the specific source is difficult to establish initially.

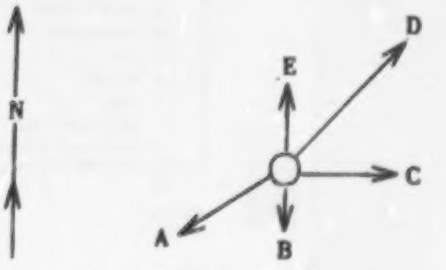
1. Determining Air Flow from Source

The basic problem in a public nuisance is to positively establish the flow of air masses from a source of air pollution to establish responsibility, or to determine relative contributions to a nuisance problem from two or more sources. This procedure is otherwise known as source tracking, and is especially applied when the source of the nuisance is originally unknown. This basically involves determination of wind direction and velocity for the purpose of triangulating the source.

In source triangulation, only two vectors are required, i.e., wind directions taken on separate occasions and locations *at times of nuisance* occurrence. Wind direction is always ascertained *from* the direction in which it is blowing. (A south wind blows from the south.) Wind direction can be determined from flags, steam or smoke plumes, finger-wetting, or, in the case of acid stains or nuisance deposits, by the pattern of increasing deposition on surfaces. A more accurate determination of air flow can be made with balloons (See "Tracking Odors," this Chapter).

The interview with the complainant should also attempt to establish, particularly in the case of odors, the wind direction at the time of contamination. In fact, the inspector should instruct complainants in recurring problems to maintain a record of time, intensity and wind direction. If this is not possible, the inspector should attempt to estimate the time the contamination is likely to occur, so that he can logically schedule reinspections.

In complex cases involving heavily industrialized communities with many possible sources, or where contamination or nuisance does not appear to be localized according to wind direction, the inspector may plot a wind rose, based on his estimates of wind direction and intensity. (See Figure XII-1.) A check with the Air Analysis Section of the A.P.C.D. may disclose prevailing wind patterns and other pertinent micrometeorological data for the area in question.



A.- 8-10:00 A.M. - 3-5 MPH
B.- 10-12:00 N - 1-2 MPH
C - 3-4:30 P.M. - 3-4 MPH
D - 2-3:00 P.M. - 5-6 MPH
E - 12-2:00 P.M. - 3-4 MPH

Figure XII-1. Plotting of a wind rose for chronological changes in direction and velocity of the wind.

A conclusive determination of air flow movement may be made by tracer studies utilizing tracer materials and aerosol filter sampling devices$^{(5,10,12,26)}$. Tracer material may consist of fluorescent dusts, spores, lycopodium powder, radio-active materials, neutron activation powders, zinc cadmium sulfide or zinc silicate, or other material which can be recognized and counted under a microscope and which range in size from 1.5 to 2 microns in diameter. Tracer materials can be either introduced into an effluent system at the source of air pollution or blown by portable blower equipment into the atmosphere near the suspected source. Inspectors may be simultaneously deployed according to wind flow for sampling in or near the reception and suspected source areas. The greater the distance to the suspected source area, the greater the number of detection stations required. The sampling is also performed either under atmospheric conditions which occur during the nuisance or during periods of atmospheric stability.

In complex cases, the following tracking results are recorded on a map: (See Figure XII-3.)

1. Location of complainants and distances from possible sources.
2. Plant source layout showing principal types of equipment which may be involved.
3. The number of complaints, and frequency of complaints as well as the time of day.
4. Observations by inspectors at various points to fill in any gaps in data.
5. The tracked contaminant routes and vectors of triangulation.
6. Wind roses or other indications of wind direction.

Of course, the requirements of each problem will dictate the type of map or notation system which will be required. Such maps are not only of assistance in systematically tracking down a nuisance, but are useful in hearings or in court cases as demonstration evidence. For such maps, the Beaufort system for designating wind direction and intensity is useful. (See Figure XII-2.)

II ODORS

The interesting fact about odors is the enormous ability of humans to respond to thousands of distinct odor stimuli, and to detect contaminants which may originate from sources at relatively great distances. Odors can be detected in concentrations of gaseous materials as low as 1 part per billion parts of air. For this reason the nose has often been characterized as one of the best known devices for gas analysis. At the same time, the average person appears to lack the necessary vocabulary to describe odors.

A major difficulty in measuring odors is that an odor is not an air contaminant but an effect of an air contaminant on humans*. To be more precise, it is a sense-perception conveyed to the brain by nerve endings and sensory cells in the nose. Like all sense perceptions, intensity of sensation depends not only on the intensity of the stimulus but on the *sensitivity* of the percipient. For this reason, the capacity in humans to

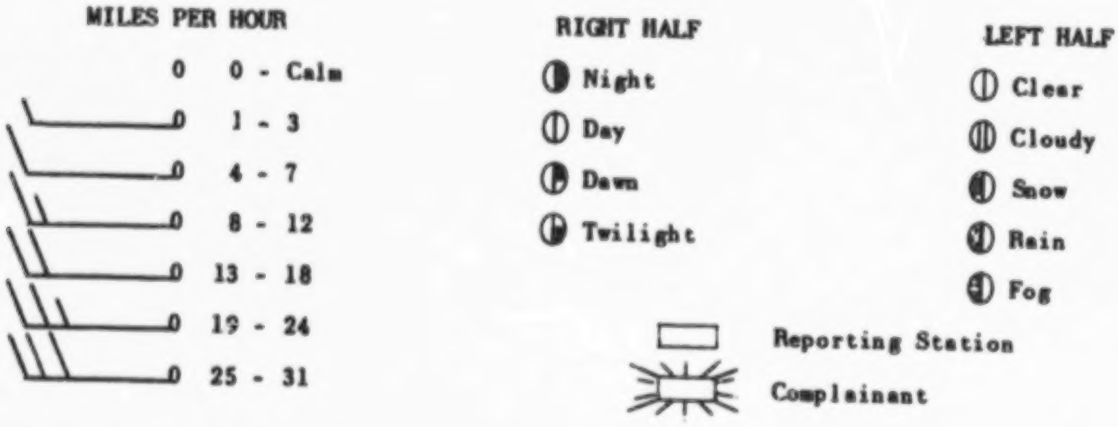


Figure XII-2. Meteorological code used as designations in fieldnuisance surveys by Johnson and Kempe (Reference 11).

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* However, Section 24208 of the California State Health and Safety Code defines an odor as an air contaminant.

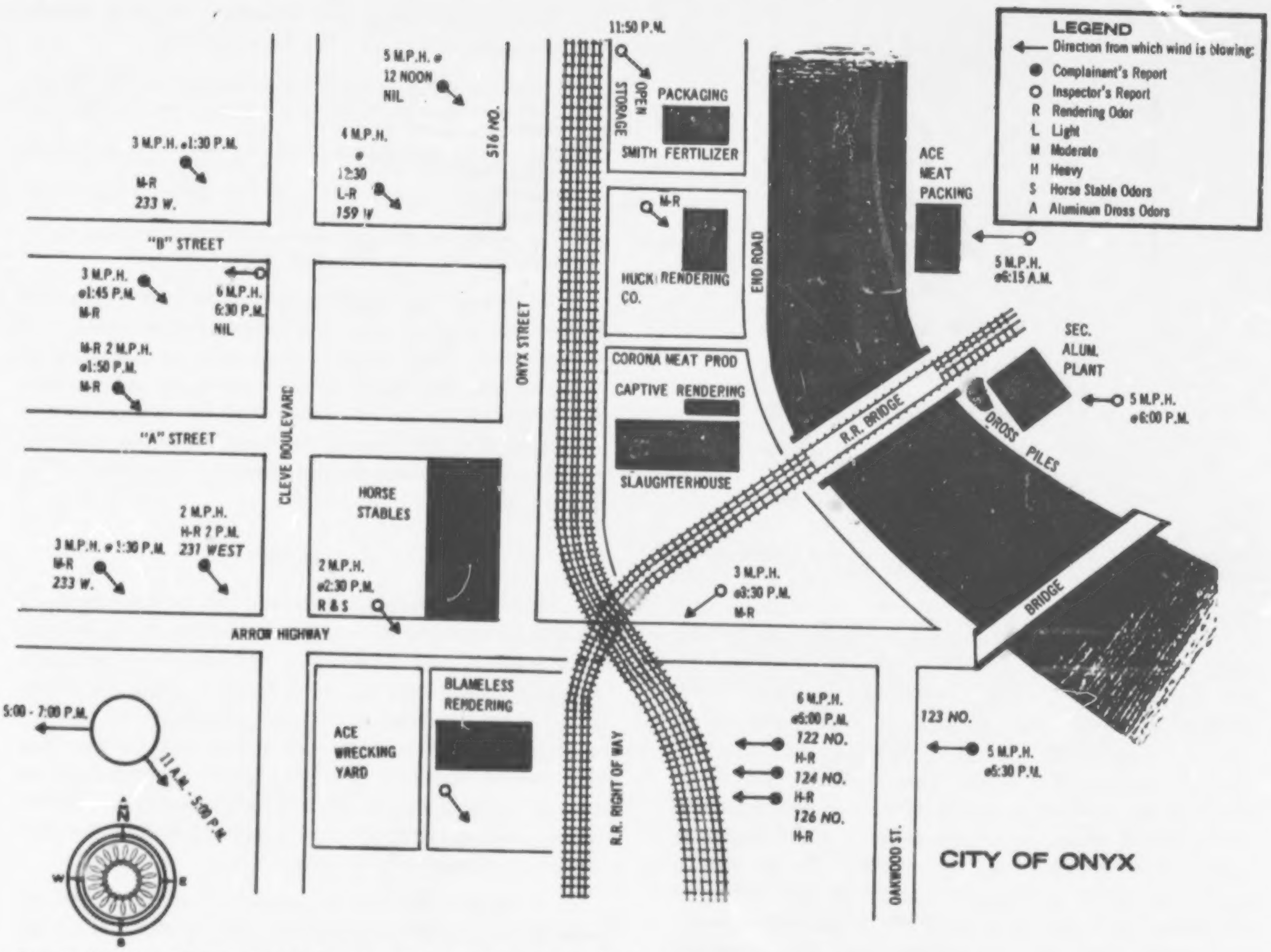

Figure XII - 3. ODOR SURVEY. Although possibly malodorous industries are centered between Onyx St. and End Road and along the Onyx Basin River, reports and observations indicate that the Blameless Rendering Company is the primary source of the odors. This finding is verified by the fact that complaints are reported in two time periods — from 11:00 A.M. to 5:00 P.M., from residents north of Arrow Highway and west of Onyx Street, when the wind was from the southeast, and from 5:00 to 7:00 P.M., from residents in the area around Oakwood Street, south of Arrow Highway, when the wind was from the west. Inspection reports, operating data and point observations verify the existence of a public nuisance at the Blameless Rendering Company.

perceive odors varies considerably, and in the same person from time to time. Some individuals are very insensitive to odors (anosmiacs) while others are acutely sensitive to odors unnoticed by most people. This fact complicates any estimate of the prevalence of an odor nuisance.

Sagarin(20) has defined odor as the "property of a substance (or substances) that is perceived, in the human higher verberbrates, by inhalation in the nasal or oral cavity; that makes an impression upon the olfactory area of the body, and that, during and as a result of such inhalation, is distinct from seeing, hearing, tasting, and feeling and does not cause or result in choking, irritation, cooling, warmth, drying, wetting and other functions foreign to the olfactory area."

This definition is of practical use to the field inspector because it distinguishes between many sensations which may be confused with odor. In the investigation of odors, the field inspector is concerned only with establishing whether or not a nuisance is odor-caused.

Any discussion of odor is likely to be extensive by virtue of the elaborate attempts that have been made to objectify this subjective experience. Psychological and even cultural factors contribute to the favorable or unfavorable perception of odors. The air pollution inspector, however, is primarily interested in a legal definition of an odor problem, i.e., a problem which is a nuisance to a considerable number of persons over a continuing or significant period of time. Both elements in the odor problem are necessary, since little can be done with an odor which occurs just once.

In such problems, the inspector is concerned with (1) identifying and rating the intensity of an odor, (2) identifying the contaminant (odorant) causing the odor, (3) locating the "odor route", (4) locating the source of the odorant, and (5) influencing some operational or engineering control over the odorant.

A. *Characteristics*

There are a few characteristics about odor perception which the inspector should be familiar with in estimating whether an odor problem exists; these are as follows: (6),(15)

1. The olfactory sense becomes fatigued after continuous perception of an odor.
2. The sensation of odor is usually detected whenever there has been a significant change in odor quality or intensity. A pleasant odor can become objectionable to one who has become used to it under continuous exposure, but increased odor intensity.
3. Odors do not, in themselves, cause physical disease. The odor of many toxic materials may serve as a warning agent, however.
4. The ability to perceive odors varies from day to day with the same person.
5. Compounds of different constitution may yield similar odors, whereas compounds of very similar constitution may yield different odors.
6. An unfamiliar odor is more likely to cause complaint than a familiar one.
7. The perception level of odors decreases with increasing humidity. High humidity tends, however, to concentrate odors within certain localities.
8. Odor quality may change upon dilution.
9. Some persons are capable of sensing certain odor qualities but not others.

B. *The Odorants and Their Sources*

It is not necessary for enforcement purposes to consider all of the odorants. Nearly all substances known, excepting those to which one is accustomed such as oxygen, have an odor. According to Moncrieff(15), potent odorants generally possess a significant degree of volatility and chemical reactivity such as are exhibited by the aldehydes and various classes of hydrocarbons. Also, materials of high vapor pressure tend to yield odors more readily than those of low vapor pressure.

The average person would find all familiar environmental odors objectionable were they strong enough. There is no problem about identifying these through mental association. Such familiar odors as coffee, gasoline, moth balls, roses, tobacco, wood smoke, jasmine, paint, skunk, do not need further definition to most people and can be termed *characteristic odors*.

However, there are many odors whose qualities are familiar though the odorants themselves are not. These are the so-called *chemical* odors, as complainants might call them, associated with chemical and petrochemical processes. The odors of skunk, garlic, onions and cabbage, for example, may arise from various sulfur compounds, ethyl, methyl, propyl and butyl mercaptans, respectively, generated from oil-refining processes. These are good examples of the fact that compounds of different constitution have similar or analagous odors. Important typical contaminants and odorants as might be found in the Los Angeles problem are listed under toxicity and physiological responses in Chapter 11.

We may further distinguish between strong, pungent "chemical" odors, which offend primarily because of *intensity*, and those which are obnoxious or malodorous because of their *quality*. It is the latter type which causes most complaints. These tend to be odors originating from the handling and processing of organic compounds containing nitrogen and sulfur. The odors arising from nitrogenous compounds may be associated with animal odors, decomposition and putrefaction of animal tissue. The odors arising from sulfur are characterized by "rotten egg", "skunk", and "decayed cabbage", as well as the acrid, bitter sulfide odors found in metallurgical operations. (Elementary sulfur and nitrogen do not exhibit odors.)

The introduction of nitrogen compounds tends to imbue substances with objectionable animal odors. Amines, in particular, can have ammoniacal, "fishy" or decayed flesh odors. In the decomposition products of protein, such as occur in the animal rendering industry, both nitrogenous and sulfurous compounds may be involved(5). These also contain hydrogen sulfide, putrescine, cadaverine, skatole, and butyric acid. Other odorous compounds not involving nitrogen include phenols and cresols employed principally in the manufacture of resins, plastics, disinfectants, inhibitors and agricultural chemicals(5, 1, 14).

Fortunately, there is fair agreement as to which activities produce obnoxious odors. Table 1, compiled by the Air Pollution Control Association, shows the types of odors most frequently reported by city bureaus. The list here is fairly typical for most industrial economies, though the order of importance may change from community to community. Animal odors such as those issuing from rendering processing are apparently the most unpleasant and are similarly unpopular in Los Angeles. The problem they present necessitates a full-scale enforcement effort.

TABLE XII-1(12)

LIST OF ODORS MOST FREQUENTLY REPORTED BY CITY BUREAUS

SOURCE OF ODOR	NO. OF THOSE REPORTED
I—ANIMAL ODORS	
1. Meat packing and rendering plants	12
2. Fish-oil odors from manufacturing plants	5
3. Poultry ranches and processing	4
II—ODORS FROM COMBUSTION PROCESSES	
1. Gasoline and diesel engine exhaust	10
2. Coke-oven and coal-gas odors (steel mills)	8
3. Maladjusted heating systems	3
III—ODORS FROM FOOD PROCESSES	
1. Coffee roasting	8
2. Restaurant odors	4
3. Bakeries	3
IV—PAINT AND RELATED INDUSTRIES	
1. Mfg. of paint, lacquer, and varnish	8
2. Paint spraying	4
3. Commercial solvents	3
V—GENERAL CHEMICAL ODORS	
1. Hydrogen Sulfide	7
2. Sulfur Dioxide	4
3. Ammonia	3
VI—GENERAL INDUSTRIAL ODORS	
1. Burning rubber from smelting & debonding	5
2. Odors from dry-cleaning shops	5
3. Fertilizer plants	4
4. Asphalt odors—roofing and street paving	4
5. Asphalt odors—manufacturing	3
6. Plastic manufacturing	3
VII—FOUNDRY ODORS	
1. Core-oven odors	4
2. Heat treating, oil quenching, and pickling	3
3. Smelting	2
VIII—ODORS FROM COMBUSTIBLE WASTE	
1. Home incinerators and backyard trash fires	4
2. City incinerators burning garbage	3
3. Open-dump fires	2
IX—REFINERY ODORS	
1. Mercaptans	3
2. Crude oil and gasoline odors	3
3. Sulphur	1
X—ODORS FROM DECOMPOSITION OF WASTE	
1. Putrefaction and oxidation—organic acids	3
2. Organic nitrogen compounds—decomposition of protein Above odors are probably related to meat processing plants.	2
3. Decomposition of lignite (plant cells)	1
XI—SEWAGE ODORS	
1. City sewers carrying industrial waste	3
2. Sewage treatment plants	2

1. Rendering Operations

Because of its universal contribution to odor nuisances, the animal rendering problem deserves special treatment here 1,14).

Animal rendering consists of reducing to solids, fats and water, animal tissue from inedible meat and bone scrap derived either from slaughterhouse remnants, or offal from poultry, dogs, cats or other animal carcasses picked up from the streets. When the rendering operation is conducted in a slaughterhouse or meat packing plant it is termed "captive" or "live rendering". Independent renderers, on the other hand, comprise the animal by-product industry and are concerned mostly with rendering the carcasses of animals salvaged from the streets. The products generally produced are tallow, grease, fertilizer, and animal feed. The processing of whole blood in a liquid form in slaughter houses or captive rendering operations yields solid blood meal which also is valuable as fertilizer and in the manufacture of glue.

Fish wastes in the cannery industry are similarly rendered to yield such by-products as fish meal, fish oil and high vitamin content residue. The odors in the case of fish reduction in canneries differ somewhat from the rendering plants described above, and are readily identified by complainants.

Rendering plant odors arise from two sources: (1) general housekeeping — the decomposition of animal tissue and offal in transit or storage prior to processing, and (2) vapor emissions from improperly controlled rendering equipment. Odors from the former are generally sharper than those from vapor emissions, which are dryer and mustier in quality.

a. "Housekeeping" Odors

A primary source of housekeeping odors results from the natural and bacterial decomposition beginning at the death of animal tissue, which produces powerful odorants whose potency increases with time and temperature. These factors are greatly responsible for obnoxious odors arising from offal whose rendering has been delayed by transportation and handling. The arrival and then storage of offal may be sufficient to create an odor nuisance before processing. Moreover, some organs such as stomachs and intestines are more odorous in themselves(27). Captive renderers, on the other hand, are not subject to this problem to the same extent as the independents since the material to be rendered is freshly acquired from the slaughter-house.

Housekeeping odors also result from spillage, improper cleaning of plant floors, and storage in the open while awaiting rendering. The handling of materials in 55-gallon drums which are not properly cleaned after use alone can create strong odors. This also applies to captive rendering plants when processing is delayed by week-end or holiday shut-downs. Monday mornings, for instance, are considered the most odorous periods in the vicinity of animal reduction plants, due to decomposed cooker feed-stock left from the previous week(1).

The problem of housekeeping maintenance at these plants is complicated by the fact that operators may either be anosmiacs or suffer from chronic odor fatigue. To control such odors greater cleanliness and sanitation in the plants are required.

b. Vapor Emissions

The second source of odors arises from vapor emissions to the atmosphere from improperly controlled process equipment. Equipment involved consists mostly of boilers, dryers, blood spray dryers, crackling bins, rendering kettles, mixers, holding tanks, storage tanks, incinerators and "catch basins." The most important part of the rendering operation is the cooking or dehydrating of the animal materials in steam-jacketed cooking vessels at temperatures generally exceeding 200°F. The cooker effluent contains mostly steam driven from the animal tissue — about 99% water. The material cooked generally varies between 35% to 50% moisture. Fat bone scrap is lower in moisture content than meat, and results in less vapor. The remaining one percent in the effluent consists of the odorous proteins and fats, hydrocarbons, and hydrocarbon derivatives — hydrogen sulfide, skatole, putrescine, and cadaverine(14). These materials may not only be highly odorous as discharged but may break down on contact with air or sunlight to form even more potent odorants.

Odors from rendering vapors may travel considerable distances and are responsible for most of the complaints from communities neighboring rendering plants. Under some atmospheric conditions such odors may travel for many miles.

2. Other Odors

Other odors commonly experienced in Los Angeles County are hydrogen sulfide emissions (rotten eggs), mercaptans (garlic and skunk odors) and "sour gases" from petroleum operations; acid mists from plating operations (dead cat odors); aluminum oxides from slag or dross piles; decayed organic matter from dumps; coffee roasting; paint, lacquer and varnish odors.

C. Description and Measurement

Whenever inspectors investigate odor complaints and attempt to establish the existence of a nuisance, they must identify the odor and odorant, describe its characteristics in terms of delineating the objectionability of the odor, and provide some notion as to its severity. Nader(16), in describing perceptual measurement of odors in the laboratory, defines the following set of subjective values which are pertinent to such an evaluation.

1. Quality
2. Intensity
3. Acceptability
4. Pervasiveness

Although developed primarily for experimental use, the values are excellent for evaluating odors in the field. Of these, quality and intensity are of direct concern to field operations. Psychologically speaking, it is perhaps best to conceive of these terms as "dimensions" or "components" of odors to place the observer in a more analytical frame of mind. To the untrained person, the odor makes primarily one impression. To the trained observer, it makes several which can be distinguished. The skill in evaluating odors is not to confuse the components of an odor sensation.

1. Pervasiveness

Pervasiveness, according to Nader, is sometimes referred to as odor potential or threshold dilution ratios.

> These essentially are a measure of the ability of an odor to pervade a large volume of dilution air and continue to possess a detectable intensity. The *odor unit*, defined as the amount of odor in a cubic foot of air at threshold intensity, is a unit of measure of odor potential. A practical measure giving information on odor potential is the threshold dilution ratio, which is the ratio of odorant concentration to its threshold concentration. A ratio of 100:1, for example, would indicate an odor potential of 100 units. This in effect means that the odorant present in a cubic foot of air is capable of odorizing 100 cu. ft. of clean air to the threshold level(16).

A pervasive odor such as might result from mercaptans and decomposed proteins, will tend to spread in all directions over a community. An inspector notes and records when tracking or establishing odor routes the general pervasiveness of odors. Such notations indicate the continuity and range of the odorant.

2. Quality

Quality describes the characteristics of odors either in terms of association with a familiar odorant, such as coffee, onions, etc. (characteristic odors) or by associating a familiar odor with an unfamiliar odorant, by analogy. Aside from such direct descriptive terms, the observer, in an attempt to be complete and accurate, may add modifiers to his description to indicate *nuance* or *overtones* to the body of an odor. These may actually include subjective reactions such as "fragrant," "foul" and "nauseating," or characteristics of odor which may be associated with the sense of taste such as "bitter," "sweet," "sour," "burnt," or even, partially with the sense of touch as far as contaminants which are irritating are concerned, such as "pungent," "acrid," "acidic," and "stinging". As a matter of fact, a contaminant may sometimes affect more than one sense. An irritant can affect the sense of smell, cause eye-irritation, and be tasted.

Odor terminology is meaningless without actual exposure through odor training. Therefore, the inspector should be exposed to samples of typical odorants found in the industrial economy, so that he can be prepared to make quick and accurate identifications. There is no substitute for this kind of training. Verbal descriptions of odors do not implant as vivid an imagery in the mind as do descriptions of visual or auditory phenomena.

A few of the well-known odor classification systems are indicated here. They are useful in training inspectors in making associations and analyzing the various component sensations which odors may produce. For field purposes, one system is as good as another. The advantage of all systems is that they yield a usable odor vocabulary.

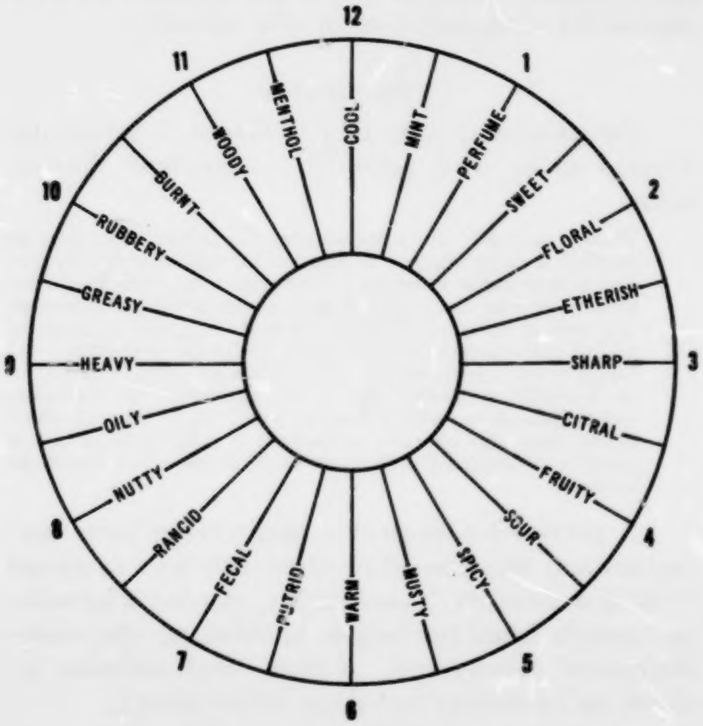

Figure XII-4. ODOR CHART. This chart attempts to present a complete range of odor terms which can be used to construct phrases of odor description. Each of these terms, moreover, can be numerically fixed from a "clock" chart for map notations, tabulations, or general reporting. Reported by Gruber, and attributed to Dean Foster, Head of the Psychophysical Laboratory at the Joseph E. Seagram Co., Louisville, Kentucky.

Henning's Odor Classification(3,13)

BASED ON SIX TYPES OF ODOR CLASSIFICATION

1. Spicy: Conspicuous in cloves, cinnamon, nutmeg, etc.
2. Flowery: Conspicuous in heliotrope, jasmine, etc.
3. Fruity: Conspicuous in apple, orange oil, vinegar, etc.
4. Resinous: Conspicuous in coniferous oils and turpentine.
5. Foul: Conspicuous in hydrogen sulfide and products of decay.
6. Burnt: Conspicuous in tarry and scorched substances.

Crocker-Henderson Classification(3,13)

A CONDENSATION OF THE HENNING ARRANGEMENT

1. Fragrant or sweet.
2. Acid or sour.
3. Burnt or empyreumatic.
4. Caprylic, goaty, or oenanthic.

3. Intensity

Intensity is some numerical or verbal indication of the strength of an odor. Intensity may remain constant, vary or fluctuate depending on air/odorant dilution rates. A gradual increase in intensity is readily detected, although persons may have become fatigued by the odor. A sudden increase in odor intensity, however, such as might be encountered by suddenly opening a flask containing ammonia or chlorine in a room has an intensity which may be characterized by an *impact*. Thus, an intensity has shock value, particularly in relation to pungent or putrid odors.

Some general mathematical relationship exists between quantity of odorant (the stimulus) and odor intensity in any given situation. Equal degrees of subjective odor intensity are stimulated by quantities of odorant which have increased geometrically rather than arithmetically. This phenomenon is described by the well-known Weber-Fechner Psychophysical Law which states that the intensity of the sensation is proportional to the logarithm of the strength of the stimulus, for middling strengths of stimuli(13,19). Odorometers and other inanimate odor detection equipment appear to verify this principle both under field and laboratory conditions. According to Gruber(9), the Scentometer, devised by the Cincinnati Bureau of Air Pollution, provides 5 odorous inlets which permit dilution of 2, 4, 8, 16 and 32 parts total air to one part odorous air on the assumption that a trained observer can detect five levels of odor intensity.

Experimental findings on the discernment of odor intensity are still incomplete. It can be said, however, that the average observer or complainant can be expected to distinguish between three intensities, weak, medium and strong, whereas the expert should be able to distinguish between those five degrees of intensity shown below and at least 16 categories of odor quality (18,19) in the following typical rating scheme:

The intensity of the odor may be noted as follows:

0 A concentration of an odorant which produces no sensation.
1 Concentration which is just detectable (the threshold dilution).
2 A distinct and definite odor whose unpleasant characteristics are revealed or foreshadowed (the recognition threshold).
3 An odor strong enough to cause a person to attempt to avoid it completely.
4 An odor so strong as to be overpowering and intolerable for any length of time.

This rating system is adapted especially for field work since it is made in terms of the behavior or response of a percipient that can be observed by an inspector. The response here is clearly one of avoidance. The fact that a person desperately attempts to avoid a strong and unpleasant odor clearly indicates the intensity of that odor.

Furthermore, we may speak here of a point at which the odor may clearly possess a nuisance value in the legal sense. Here again, depending on the number of complainants, the desires of the complainants to be witnesses, and the consistency and persistence of the complaints, odor intensities from #2 on may be capable of establishing a legal nuisance.

D. *Tracking Odors*

During the inventory inspection conducted at all of the industrial plants, inspectors attempt to initiate correction on all odor potential processes in order to prevent nuisances. It should be kept in mind, however, that if a plant is otherwise in compliance, but produces odors, no nuisance is involved if no one is affected. The plant, therefore, is not obligated to prevent the odors. Nevertheless, in such cases, the inspector describes the odor potential on his reports in the event that complaints are received regarding that type of odor so that the source may be readily located.

In most odor problems tracking is unnecessary. An experienced inspector is often able to identify the source of an odor by its quality and intensity and may be able to relate the odor to a specific activity. Since inspectors are familiar with the industrial establishments in their inspection sectors, they are often able to connect the odor with a specific piece of equipment.

The field inspector verifies his findings by following a definite odor route in order that he may prove that the odor emanates from a specific piece of equipment. In such tracking situations it is not necessary to rate odors numerically, but to describe the odors as they are perceived. In these cases the inspector either follows the odor from the suspected source as it moves downwind to effect areas, or he proceeds from an effect area (i.e., from the complainants themselves) upwind to the source. The first method is for verification, the second for tracking an unknown source.

1. Point Observations

The purpose of tracking odors or making odor surveys is (1) to locate an unidentified source of an odor, and (2) to prove to the satisfaction of the courts that a given odor results from a contaminant emanating from a specific source or sources. The proof can only be made by an expert witness, the inspector, familiar with odors and the equipment and operations located in a suspected area.

An odor may be tied to the source by two basic processes: (1) Association of odor with odorant, and thence with a source. A given putrescent odor, for example, is associated with protein decomposition, and that in turn, depending upon the quality, with either cooking or rendering processes. Such an odor may be legitimately called "rendering odor", that is, by the name of the odorant or the process producing it, and (2) by a process of eliminating plants incapable of emitting the odorant. Inventory records can be perused, or a key sorting selective analyses operation at Headquarters employed to locate all suspected equipment in the plants in a given source area.

The consensus of odor quality in the complaint area must be identical to the odor quality emanating from the source* That is, with the exception of "intensity" all significant point observations should agree. The "intensity" should vary in a geographical pattern. A *point observation* here is a stationary location at which an evaluation was made of the following:

1. Odor quality and intensity.
2. Wind direction and strength at time of odor.
3. Duration of odor.
4. Time of day and date.

Each nuisance complaint represents a point of observation. Either the inspector verifies the complainant's information, or if there are so many complainants that he cannot do so, he requests the complainant to keep a record of this information. The pattern of complaints may thus, in itself, delineate a vector which will point upwind to the source. Especially is this true when complainant locations form a circle or a crescent on a map, when odors are reported under relatively stable weather conditions. The projected center of any circular locus of point observations can be assumed to be the source area.

Where an insufficient number of point observations are disclosed, inspectors make scheduled point observations in order to triangulate the source. At such point observations, the inspector may, when odors are detected, take several samples of the air with evacuated flasks. One flask can be used for comparison purposes in an odor-free room at Headquarters and another for lab analysis of the odorants. For even more effective analysis, odorants can be sampled from the atmosphere at point observations by activated carbon sorption or by freeze-out trapping; analysis can then be made by infrared or mass spectrometry.

2. Micrometeorological Problems

Several complications with respect to odors due to the micrometeorology of given areas may arise. These are the distances and elevations at which odored streams of air travel. The distance at which an odor travels may be very considerable. Sour gas odors from oil fields have traveled as much as 100 miles from a source, though this instance is rare(13). Where meteorological conditions are favorable to odor dissemination, the radius will not generally exceed 5 to 10 miles. In Los Angeles County most odors seem to be confined in an area ½ to 2 miles in radius due to stagnant air conditions. Odor dissipation may depend on temperature, humidity, wind velocity and steadiness of prevailing wind.

Some estimate of wind velocity may be useful in determining relative distances at which a source might be located from the complaint area. A weak breeze, for example, suggests that a source may be nearby, since a slow moving odor stream may dissipate by diffusion before it is carried very far. If the breeze is strong, on the other hand, and no suspected sources are nearby, the odor may have traveled a long distance, especially if it is a particularly pervasive odor.

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* This is sometimes complicated by changes in odor quality in some substances resulting from variations in dilution ratios.

The tracking of an odor from a complaint area to a source is a matter of approaching an increasing intensity of a given quality of odor. This can be accomplished by making representative point observations along the odor route. To avoid odor fatigue, inspectors may travel with their vehicle windows closed to maintain as relatively odor-free vehicle as possible, then open them upon arrival at a new point observation for purpose of comparison(8).

Actual "skips" in the odor route may be observed due to local turbulence, eddies, etc. Odorants may also travel in air streams at varying elevations above the ground, then strike a neighborhood or community situated on a rise of land.

To positively establish an "odor route", Gruber(9) suggests the use of balloons to plot low-level wind directions along the path of the wind itself. He suggests partially inflating such balloons with helium gas so that they will rise slowly and indicate a low-level wind direction which can be plotted with a compass and recorded on a map.

3. Approaching the Plant

The inspector in tracking problems travels towards the plant on its downwind side and notes the intensity of the odor. In more complicated cases, several radio-equipped cars are deployed to transmit intensities which are then recorded and interpreted at the communication center. Several cars may be necessary when the odor fluctuates. the wind direction changes, or a complex of possible sources in an area makes positive identification of a source difficult.

If the odor is traced to an industrial community and to a group of industrial plants all performing similar industrial operations, it will be necessary to determine whether all of the plants, a few, or just one plant is responsible. Because the responsibility must be clearly determined, a studied surveillance of the inside and outside of each suspected plant may be required. Action can be taken against multiple sources, as well as single sources, as long as the odor concentration arising from each, and together, can account for the intensities noted.

If the odor is not chronic, and was reported for the first time, it may be due to deviation in operational practice, to a breakdown of equipment or to the introduction of a new process. Because of these probabilities, a one-time odor is likely to originate from one industrial source. An inspection of the plant may disclose the specific operation which has caused the nuisance. When the inspector has traced the odor to the equipment, he must fully document the conditions under which the malodorous contaminants were emitted.

Although the odors which are detected in the field arise from the diffusion of gases and vapors, the source of the odors may be in solid or liquid form. Samples of petroleum products, chemical fluxes, solvents, decomposed organic matter, materials from open dumps, etc., can be taken as evidence, or the material can be photographed. The fact that substances may have vapor pressures sufficient to yield an odor or have low odor thresholds can be substantiated by expert testimony, as long as other operational and conditioning factors which caused the odor are reported.

4. Sampling and Measurement of Intensity

To confirm field estimates of odor intensity in nuisance problems, or to determine odor removal efficiency of odor control equipment, the inspector may collect samples of odorous gases low in moisture content by means of a Pyrex glass probe connected by a ball and socket joint with clamp to a 250 ml. MSA gas collection tube as shown in Figure XII-5. The odorous gas is drawn into the tube by means of a rubber squeeze bulb evacuator. For gases highly laden with moisture, such as may be found in steam plumes, a special means of collection(29) is required to prevent condensation of water vapor and possible absorption of odor by the water. In this method, a capillary glass tube, and a hypodermic needle and medical syringe are used to draw 10 ml. of the sample into a collection tube containing odor-free air.

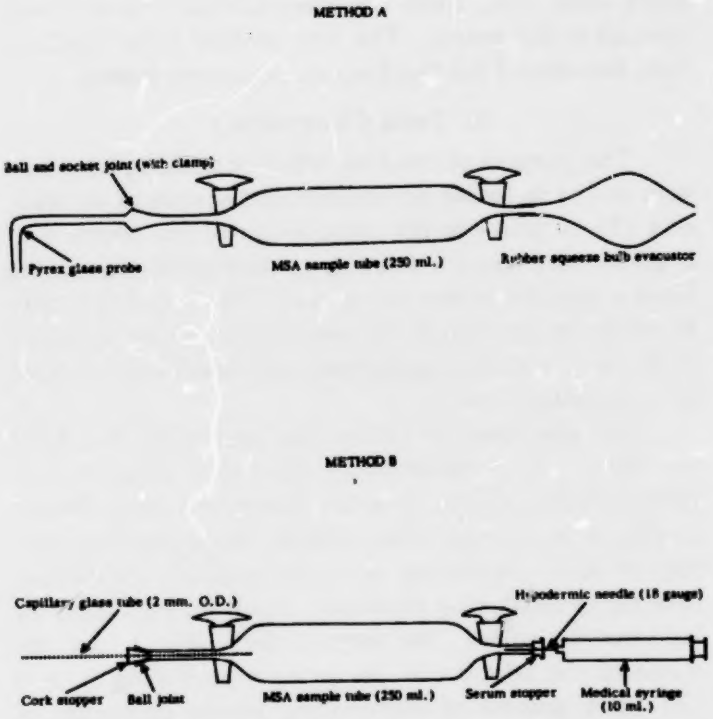
METHOD A
Ball and socket joint (with clamp)
Pyrex glass probe
MSA sample tube (250 ml.)
Rubber squeeze bulb evacuator
METHOD B
Capillary glass tube (2 mm. O.D.)
Hypodermic needle (18 gauge)
Cork stopper
Ball joint
MSA sample tube (250 ml.)
Serum stopper
Medical syringe (10 ml.)

Figure XII-5. Schematic diagrams of odor sampling apparatus. Method "A" is used to collect samples low in moisture content; Method "B," samples high in moisture content. The latter method permits primary dilution of odor sample in the field, and minimizes condensation of vapors on the inner surface of the sample tube.

At the laboratory, the original sample of gas is diluted with pure air until a dilution is achieved at which only 50% or less of the members of an expert test panel can detect any odor. The procedure employed by the A.P.C.D. is a slightly modified version of the ASTM Standard Method D 1391-57, "Standard Method for Measurement of Odor in Atmospheres (Dilution Method)"(29). The amount of dilution necessary to dilute gas to the odor threshold measures the relative amount of the odor in the gas. The relationship of the field estimate of the odor intensity of the original sample or nuisance to the odor threshold can be compared for use as evidence in court.

5. Reporting

In concluding odor investigations, the maps (Figure XII-3) and reports collated from the various inspections can be perused to establish the elements of a public nuisance. Reports are used to record data compiled at each point observation. In simpler cases, odor surveys or maps are not required. A written account either in tabular or narrative form reporting the approach to an increasing intensity, as well as notations regarding the elimination of industrial plants which might have been logically suspected as contributors, may be all that is required. Here, again, the process of elimination is just as important as that of positive identification.

E. *Odor Control*

The elimination of odors is the most important part of any odor problem. Air contaminants responsible for an odor should be controlled so that threshold concentrations are never reached in the outdoor atmosphere. This is accomplished by adopting any one or a combination of control devices or techniques such as waste gas incinerators, catalytic oxidation, adsorption in activated carbon, masking, counter-action, etc., to the odor source(24,25). Such common-sense control methods as general sanitation, refrigeration of animal tissue, improved maintenance and operational techniques should also be applied where odors arise from plant housekeeping.

The abatement of odors is accomplished either by complete destruction of odorants and prevention of odorant emissions, or neutralizing the malodorous effects of contaminants. Odor prevention or odor destruction is generally preferable since air pollution control in critical pollution areas seeks control of contaminants themselves, not the effects of contaminants. For this reason, the ideal odor control method is perfect combustion. This is accomplished by an afterburner or waste gas incinerator. To be effective, such devices must maintain complete combustion at proper temperatures and exposure times, reducing all contaminants to odorless water and carbon dioxide. Partial or incomplete combustion may result in a series of reactive secondary products which may not only be malodorous, but eye-irritating and corrosive as well.

1. Waste-Odor Incineration

In Los Angeles County, afterburners have been successfully employed in a large variety of situations to abate odors from refineries, rendering, paint and varnish, sulfur recovery, coffee roasters and fish processing plants and enameling ovens and dryers, paint and enameling baking ovens, chute type incinerators and smoke houses in meat packing plants.

Their use is made compulsory in connection with rendering processes by Rule 64, quoted in full below:

> RULE 64. REDUCTION OF ANIMAL MATTER. A person shall not operate or use any article, machine, equipment or other contrivance for the reduction of animal matter unless all gases, vapors and gas-entrained effluents from such an article, machine, equipment or other contrivance are:
>
> a. Incinerated at temperatures of not less than 1200 degrees Fahrenheit for a period of not less than 0.3 second, or
>
> b. Processed in a manner determined by the Air Polution Control Officer to be equally, or more, effective for the purpose of air pollution control than (a) above.
>
> A person incinerating or processing gases, vapors or gas-entrained effluents pursuant to this rule shall provide, properly install and maintain in calibration, in good working order and in operation devices, as specified in the Authority to Construct or Permit to Operate or as specified by the Air Pollution Control Officer, for indicating temperature, pressure or other operating conditions.
>
> For the purpose of this rule, "reduction" is defined as any heated process, including rendering, cooking, drying, dehydrating, digesting, evaporating and protein concentrating.
>
> The provisions of this rule shall not apply to any article, machine, equipment or other contrivance used exclusively for the processing of food for human consumption.
>
> This rule shall be effective on the date of its adoption as to any article, machine, equipment or other contrivance used for the reduction of animal matter not completed and put into service. As to all other such articles, machines, equipment or other contrivances this rule shall be effective October 1, 1959.

In enforcing Rule 64 at rendering plants it is first important to ascertain the adequacy of vapor collection and disposal facilities. The emissions from the kettles are conveyed by ductwork to a condenser where most of the moisture is removed. The noncondensables, including the odorants not removed by the condensers, are burned in an afterburner or in the firebox of a boiler which meets the requirements of Rule 64. The inspector thoroughly checks all equipment for leaks or breaks in ductworks, or for negligent operation of kettles, or any other conditions which may result in vapor emissions.

When applications for rendering or rendering control equipment are processed for permits, the control engineer determines whether or not sufficient gas is available to provide the minimum required temperature for combustion of odorants, and calculates to determine proper retention time. This is necessary to meet the law and to incinerate the materials properly. The inspector determines compliance with the temperature restriction and checks for obvious changes which might reduce the retention time, such as alteration of combustion zone dimensions.

The inspector must check the operation of the afterburner, and the calibration of the pyrometers. A company which desires to evade the rules need only corrupt the electrical system of the recording equipment, merely, for example, by altering the leads to the thermocouple. The inspector may do his own electrical verification by using a pyrometer furnished him.

Waste gas streams can also be incinerated in the fireboxes of waste heat boilers provided that the same conditions for combustion obtain as above.

Other methods of preventing the escape of odors to the atmosphere include chemical scrubbing and charcoal filtering. These methods of control have been described in Chapter 2.

2. Neutralization

The neutralization of odors is not concerned with the reduction of odorants but with nullifying both the quality and intensity of the odor by means of mixing anti-odorant materials with the odorants, usually by atomization. The result is primarily psychological. These anti-odorants are: (1) masking agents, (2) counteractants, and (3) chemical reactants.

a. Masking Agents

A masking agent is an odorant with pleasant qualities strong enough to subordinate the stimulus of the unpleasant odorant. It is usually prepared from synthetic aromatic chemicals, their by-products, various essential oils, and is used in odor control in industries manufacturing solvents, fuels, rubbers, plastics and textiles.

b. Counteractants

Counteractants involve the pairing of odors which counteract each other, i.e., by being present in effective proportions, make the perception of odor completely unnoticeable. Rubber and paraffin, cedarwood and rubber are two familiar examples of counteractants. Counteractants are also prepared from synthetic aromatic compounds, various essential oils, with the addition of quaternary ammonium compounds and disinfectants.

c. Chemical Reactants

These "deodorize" by chemical alteration of the odorant itself. Reactants include such chemicals as ozone, chlorine, chlorine dioxide, permanganate, organic peroxides, formaldehydes, or catalytic materials, etc.

III NUISANCE DEPOSITS — STAINS

Stains refer to the damaging or soiling of property resulting from the interaction between air contaminants and the surfaces or surface coatings of materials. In nuisance problems, typical stains include pitting, incrustation, etching, spotting, buckling, abrasion, corrosion and other forms of deterioration.

Stains usually result from the deposition of mist droplets or liquid particulates usually of an acidic or caustic nature. Some solid particulates and aerosols may also exhibit staining or damaging properties. Dust particles will contribute to deterioration of materials by abrasion and erosion, or by chemical or electrochemical reaction. For example, ammonium sulfate silica, produced on carbon particles which have absorbed sulfur dioxide, tends to increase the general corrodibility of the atmosphere.

Since solid deposits are treated separately in Section IV of this chapter, a stain shall be considered here as any significant deposition or damage resulting from the chemical reaction between a mist droplet and the surface of a material.

The type of nuisance found in a community as a result of mists depends on the nature of the industrial economy and the climate, particularly with respect to sunlight and humidity. Humidity increases the rate of corrosion, as well as influencing mist production. Sunlight induces photochemical reactions and catalytic reactions leading to the formation of oxidants. A typical corrosive atmosphere found in urban communities today is one which contains a high degree of sulfur dioxide. Sulfur dioxide in the atmosphere, as will be recalled, readily converts to other aggressive substances. Hydrogen sulfide and sulfuric acid will attack lead-based paints, leaving a brown to black discoloration. Sulfuric acid, also, will attack a variety of substances, including building materials such as carbonate-bearing stone, zinc gutters, canvas, copper wire and surface coatings. The properties of this type of contamination have been previously discussed in this manual.

Local nuisances resulting from liquid particulates tend to fall into two categories: (1) acid and caustic stains causing some form of permanent damage to property, and (2) spotting by paints, oil, greases or other materials which adhere to surfaces without necessarily damaging them and which can be removed.

A. Damage by Acids and Caustics

A frequent type of public nuisance encountered in Los Angeles concerns the discoloration and damage of lead-based paints, particularly automobile finishes, by acids. Acid stains usually appear as brown-going-to-black irregular pin pricks to spots which range in size to approximately ¼" in diameter, shaped in the cross-section of the depositing mist droplet. Cars so damaged exhibit a spotty appearance, particularly on the upper surfaces of the vehicle — the hood, decks and roof, or on the side of the car facing into the wind. Cars found in employee parking lots in industrial communities are most frequently affected by this form of contamination and occasionally cases develop in which the cars affected are owned by the employees of the company creating the nuisance, thus involving an employee-employer management problem which must be resolved by cooperative action. In other cases where acid deposits are found, the source is usually located close by, although this may not always be true. House-sidings, usually discolored from yellow-to-black, steel fencing and uncoated aluminum sidings on houses and trailers may also be affected by acid contaminants.

Virtually all acids in appropriate concentrations by their nature contain properties of a potentially nuisance character. They will attack and discolor materials, dissolve or corrode metals, oxides and carbonates, burn or ulcerate skin, irritate the eyes and cause a sour taste. The acidity of aqueous solutions can be measured quantitatively by the pH factor. The pH factor, a measure of the reactivity of a solution, is based on the fact that an acid contains hydrogen which may be replaced by a metal to form a salt. Thus, reactivity is measured in terms of the hydrogen-ion concentration of a solution by means of electrometric apparatus or colorimetric indicators (pH or Hydrion papers, see Figure XI-10F).

The types of acids found in nuisances depend, of course, on the particular industrial plants and processes employed, and hence, on the general nature of the industrial economy. Some acids like phosphoric acid, used in the production of fertilizers, ceramic and glass products, phosphoric acid anodizing, petroleum refining, catalysts, and cleaning of metals are capable of attacking canvas and aluminum sidings and will cause incrustations on automobile finishes which, however, can be wiped off. Nitric and nitrous acids, which may be emitted as a brown cloud in by-product manufacturing or fertilizer processing, may also give off irritating corrosive mists. Hydrochloric acid, which is emitted as a by-product in the manufacture of chlorine products, used in the manufacture of scale solvent, in making swimming pool acidic adjustments, in pickling processes, etc., will attack metal fencing and similar materials.

The three most important acid mists entering into public nuisances in Los Angeles County are chromic, sulfuric and hydrofluoric acids. We shall consider these acids as being emitted directly into the atmosphere and condensing out as dew, mist or rain, rather than the type of acid which subsequently results from atmospheric processes. These acids are not usually emitted as a regular consequence of production cycles, but usually as a result of accident or equipment failure. Most plant operators, for reasons of health and safety, attempt to maintain careful control over acid handling. When air pollution control equipment fails, acid particles build up with moisture on control surfaces (entrainment) and are dumped or exhausted into the atmosphere under draft pressure.

1. Chromic Acid

In addition to attacking paint, chromic acid mists are also capable of causing eye-irritation and offensive ("dead cat") odors. The primary source of chromic acid mist is inadequately controlled electrolytic chromium plating tanks. Chromic acid mist results from the fact that hydrogen and oxygen bubbles, released electrolytically, pick up particles of the acidified solution formed in the film on the surface of the tank. Generally speaking, such nuisances arise from hard chrome rather than soft (decorative) chrome plating operations, since in the former greater current densities and higher bath temperatures are applied, thus creating more side reactions and increasing the rate of emission of liquid particulates. Typical solution compositions for both soft and hard chrome plating are .53 ounces of chromic acid per gallon solution. Typical current density and bath temperature for soft chrome are 115 amps. per sq. ft. and 105°F; for hard chrome, 216-288 amps. per sq. ft. at 122°F. Such operations can be controlled by a commercial mist inhibitor or surface-active agent, which breaks up surface tension and keeps the particles which would ordinarily form a surface film in solution, or by the use of wet collection or dry-type filters described in Chapter 2.

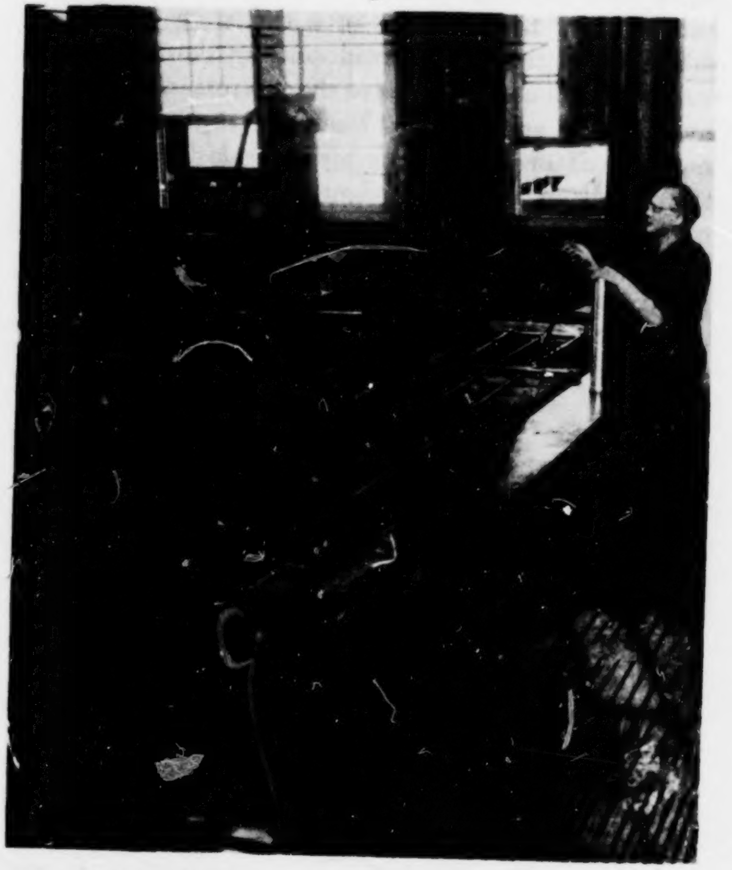

Figure XII - 6. Hard chrome plating tank used for coating diesel engine crankshafts.

2. Sulfuric Acid

Because sulfuric acid is one of the most economical of the inorganic acids, it is widely used in industrial operations to remove sulfur and unsaturated compounds, in battery manufacturing, for purification and in many refinery and plating processes. Sulfuric acid mist droplets are capable of producing brown to black discolorations and pitting on lead-based surface coatings. Another familiar nuisance effect is the deposition of sulfuric acid either directly or indirectly in the troughs formed in the slack of canvas awnings. Sulfuric acid will destroy materials wherever it is permitted to accumulate.

3. Hydrofluoric Acid

Hydrofluoric acid readily fumes and is capable of severely attacking skin, poisoning leafy vegetables and flowers, and pitting glass and metal. It is used in the commercial production of fluorides, in metallic aluminum and metal fluorides, insecticides and laundry products. It is prominently used in the etching, frosting and polishing of glass and as a catalyst in the conversion of olefins and isoparrafins in alkylation plants in refineries, as well as in the pickling of steel alloys. It will distinguish itself from the other acids by causing comprehensive damage. When it attacks an automobile, for example, it will contaminate the paint, chrome and glass. Because of the high degree of acitivity of this contaminant, and its danger to health, equipment and vegetation, it is handled and controlled carefully by maintenance in a dry state or in such dilute quantities as to avoid causing damage in the vicinity of its use. Because of the interest in its control, hydrofluoric acid is more likely to create a one-time nuisance as a result of equipment break-down, particularly from an alkylation plant, rather than a continuing chronic public nuisance. It may also occur as a by-product in the manufacture of rocks and phosphates when sand used in its control is spent. (Hydrofluoric acid reacts with silica, or sand, to form hydrofluosilic acid.)

4. Caustics

Caustics fall into the chemical category of alkalies, that is, they are capable of neutralizing acids as well as providing a detergent, and in some caustics, an etching action. Principal caustics are sodium carbonate and sodium hydroxide, the latter being more commonly used. Sodium carbonate is used in large scale chemical manufacturing, the manufacture of glass, soap powders and detergents. Of the caustics, sodium hydroxide is perhaps the most significant since it attacks the skin, is strongly alkaline, and very soluble. It is employed in the petroleum industry, in the viscose process for rayon manufacturing, and the manufacturing of chemicals and soaps. In sufficient concentrations it will attack paint, glass, and aluminum and cause pitting, etching and buckling. The etching properties of this chemical are put to use in the aircraft industry in a chemical milling process which reduces the thickness of preformed, stress-relieved aircraft parts made of aluminum, magnesium, stainless steel and titanium. This chemical process performs milling jobs such as shaping and tapering and can mill surfaces at the rate of one-thousandth of an inch per minute. The chem-mill bath consists of a caustic etching solution of 7% sodium hydroxide by weight, water and a trace of sodium aluminate, and is heated to about 195°F. The sodium hydroxide mists are usually vented by means of slot hoods to a water scrubber. If uncontrolled, chem-milling may cause a public nuisance.

B. *Spotting by Paints and Other Materials*

Here we consider the type of nuisance which results from the deposition of paint, oil, grease droplets or other materials which adhere to surfaces or surface coatings without necessarily damaging them. Quite often such deposits are readily removed with water, thinners, or detergents. In some cases, surfaces may require rebuffing and repainting. The droplets of this type are generally significantly larger or heavier than those described previously and enter the atmosphere directly from spray or atomizing devices, and occasionally by entrainment and ejection from wet collection equipment or blower exhaust systems. They frequently contribute to the contamination of automobiles, house sidings, clothing, etc. in the community in which the spraying is performed.

1. Paint Spots

Paint spots are mist droplets of paint pigments and binders which deposit in a liquid state and adhere to surfaces. Paint mists are frequently emitted from paint spraying operations usually conducted under high-volume production conditions. With average wind movement and humidity, all paints tend to fall out within the first 150 to 500 feet from the source with the exception of certain metallic pigmented paints, such as aluminum, which may on occasion travel upwards to one-half of a mile.

The important nuisance properties of paint droplets are the drying rate, the distance traveled, and the degree of surface adhesion. The speed at which paints dry depends primarily on the rate of evaporation of the volatile portion (solvents) contained in the paint. Paints containing slow-drying solvents may travel in the air as mist droplets which then dry after deposition on surfaces. Paints which require heating or baking for drying are generally of this type. Baking enamel, for this reason, is a basic source of public nuisances. Primers, sealers and water-based paints, although emitted as a liquid are deposited as solids and have the appearance of colored dust, depending on the relative distance between the source and the surface. Zinc chromate primer, for example, is yellow-green, while lead primer is red.

Paints also give off characteristic odors usually due to the evaporation of the organic solvents (varnishes or oils) contained in the vehicle of the paint. The principal vehicles used are oleoresinous varnishes, alkyds, dispersion resins, malamine and phenolics(22). An odor problem from paint is generally not significant unless complainants are very close to the source.

The uses and relative nuisance properties of commonly used paints are described below in Table XII-2. Drying rates, it should be noted, vary considerably within any category of coating, depending on the initial drying or "flash-off" of the specific solvents. Those shown below are for typical industrial situations.

TABLE XII-2(4)

RELATIVE NUISANCE PROPERTIES OF COMMONLY USED PAINTS

COATING	USE	DRYING RATE	REMOVAL
Clear lacquer	Used for wood and metal finishing and as sealer.	Fast, air drying.	Very light and volatile. May be removed with lacquer thinner.*
Pigmented lacquer	For painting automobiles, or metal surfaces, for rapid drying (Alkyd resin).	Fast, air drying.	With lacquer thinner.*
Lacquer enamel	Same as above, but bake dried.	Bake dry, slow air drying.	With lacquer thinner.*
Synthetic enamel	Automobiles, refrigerators, stoves, lighting fixtures, etc.	Fast-slow air drying.	With lacquer thinner.*
Primer	Undercoating may use all types of resins and pigments such as red lead and zinc chromate.	Very fast drying.	Usually dries to dust. May be easily rubbed off.
Clear sealer	Non-pigmented primer.	Fast to slow.	Same as above. may be removed.
Water-based paint	Emulsified with water; mannikins, papier - maché, houses, etc.	Very fast drying.	Same as above.
Metallic pigmented enamel	Painting large storage tanks, an economical protective coating.	Usually medium-slow, light, may travel long distances.	Aluminum-metallic paint adheres, may be removed with mineral spirits or thinner.

* Since lacquer thinner is a strong solvent, caution must be taken with its use in removal of paint stains, as it may also damage the protective coating.

Paints are capable of causing nuisances when they are sprayed or atomized, usually with standard pressure spray guns. Paint spraying may be conducted in the open or in one of several types of specially constructed paint spray booths. "Open spraying" is conducted outdoors on structures so large that it is impractical or uneconomical to utilize a paint spray booth; for example, the spraying of houses, structural steel beams, etc. However, most spraying, for reasons of economy and safety, and fire and health department restrictions, are conducted within a suitably designed paint spray booth. The article to be coated is placed or mounted in the booth either on a pedestal or conveyorized assembly unit, and is sprayed by an operator and occasionally by automatic spray equipment.

The types of paint spraying operations employed depend on the nature of the material to be coated — wood, plastic, metal; the quality of the surface, i.e., smooth, rough, porous, etc., and the quality of the surface coating desired, i.e., hardness, permanence, luster, etc.(22) Woodworking, metal fabrication plants, and automobile and aircraft manufacturing and repair plants are most generally encountered in air pollution problems, although paint spraying operations tend to be common to the entire industrial economy. Woodworking techniques include conditioning of the article by means of sanding, application of sealer, stain (either oil or water-based) and application of final coat of lacquer. In plants manufacturing metal products, articles to be coated may be conditioned by degreasing with vapor solvents and buffing, and primers may be applied as undercoating. Lacquer-enamels, synthetic-enamels or metallic pigmented enamels are applied as a finishing coating. To improve the properties of adhesion, hardness and resistance to chemical deterioration, painted articles, such as automobiles and other metal products are baked or force-dried in ovens at temperatures ranging from 150° to 400°F. In small plant operations one booth may be used for applications of preparatory and final coatings, whereas in large conveyorized assembly-line plants, a paint spray booth may be utilized for each type of spray operation conducted.

The design of the booth, the equipment used, and the type and volume of paints sprayed affect directly the amount of air contaminants emitted. Booth design generally falls into two categories: dry and wet types.

The simplest dry-type booth is merely an enclosed structure equipped with a blower motor fan and stack. The size of the booth depends on the size of the objects to be sprayed, and the blower motor and fan diameter are rated to handle the volumes of paint sprayed and the dilution necessary to keep the air in the booth clear. The amount of paint mist entering the exhaust flow after spraying depends on the size and nature of the article being sprayed. A large flat article will retain most of the spray whereas smaller objects, or those which are gridded or perforated, result in a greater *overspray*.

Although the walls and ceiling of the simple dry type booth retain some of the overspray, most of the mists and vapors are drawn out through the blower system to the outer atmosphere. To reduce emissions of these contaminants, flat metal panels, or baffles, are constructed as impact surfaces at approximately right angles to the air flow entering the outlet of the booth. Depending upon the percentage of the cross-section of the exhaust outlet obstructed by the baffles, a proportion of the overspray is deposited and retained on the baffles.

A more advanced type of booth employs filters packed with a dry filter medium, such as glass fiber, fine wire, metallic screening, or crimped paper. These are constructed in banks breaching the exhaust passages of the booth. The efficiency of such filtering media is relatively high for all paint particles.

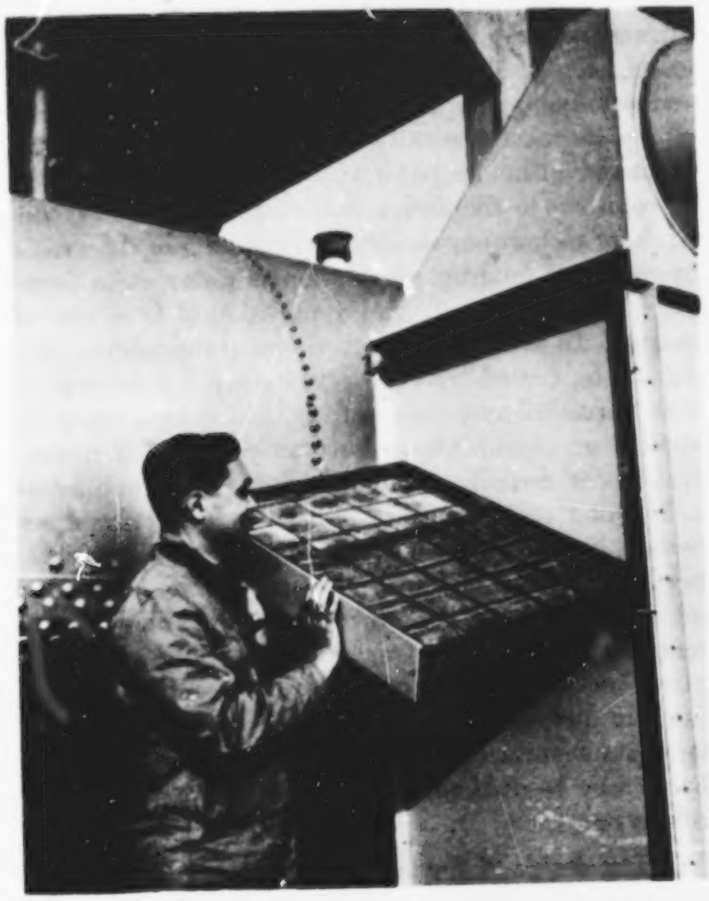

Figure XII - 7. Placing dry filter tray into spray booth.

An even more efficient design of booth is of the wet-type. This type of booth is a special form of water scrubber constructed in the form of a recirculating waterfall curtain which entrains the paint mist before it is exhausted to the outer atmosphere. The paint particles then are scrubbed out of the flow by a detergent, are collected in a settling tank, and recirculated.

The more advanced of these booths are capable of collecting practically all types of liquid particulates. Some odors, however, will be emitted, and the emission of volatile solvents is, at the present time, uncontrollable.

The effectiveness of the control features of all booths depends upon proper operation and maintenance. Skilled operators attempt to reduce unnecessary overspray, not only to prevent air pollution but to conserve paint. Pressure guns are operated only when necessary and with such skill as to accomplish an efficient and uniform coating of the article. Automatic electronic spray devices have been recently developed in which the paint particles are given an electric charge and are attracted to the article to be coated on a grounded conveyor belt, in an electrostatic field created by rows of fine wires on each side of the conveyor.(28)

Booths utilizing dry-type filter media will require that filter media be changed or replaced whenever there is a significant drop in draft pressure. Agglomerated contaminants in neglected and overloaded filter media will be forced into the atmosphere by draft pressure. Wet booths require constant recirculation of water and the use of a suitable chemical detergent to keep the curtain flow clean. Periodic cleaning of the booth is necessary to prevent stoppages in drainage and pumping systems which otherwise might result in exhausting portions of the contaminated solution into the atmosphere.

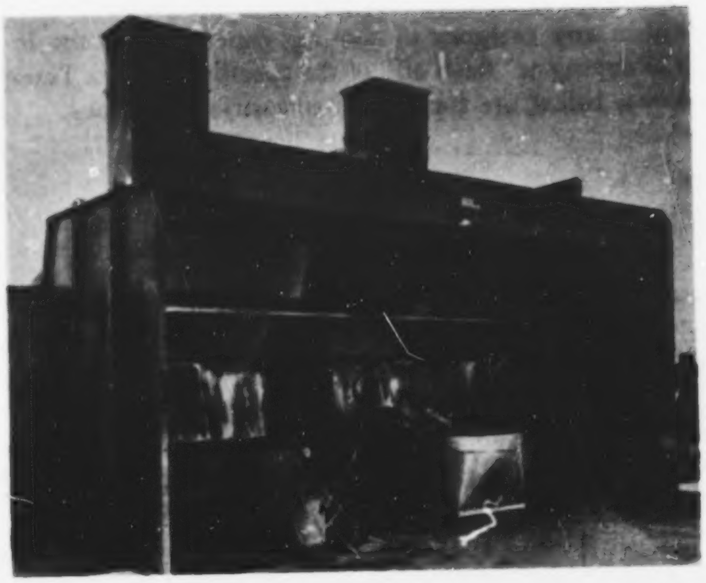

Figure XII-8. Recirculating water-fall paint spray booth.

The design standards which must be met by paint spray booths are determined both by engineering calculation and empirically in the field. The amount of contaminants emitted into the air is readily determined from the estimate of overspray, production quantities of paints and thinners used, the scrubbing or filtering ratio, indraft and cross-draft velocities as well as the volume of air (CFM) moving through the control sections of the booth. The data are routinely calculated in processing applications for permits in determining whether the proper type booth is employed for any specific operation.

2. Other Materials

Other spotting, sometimes similar to acid or paint stains, can occur from a variety of industrial and non-industrial sources. A familiar problem encountered in Los Angeles involves spots on houses and cars resulting from bee droppings. These have a characteristic light to dark yellow, orange or brown appearance, round or oval on horizontal surfaces (.15" to .20" in diameter) or as streaks on vertical surfaces (.05 to .1" long), with a waxy consistency when fresh. On aging, bee spots become dark grey-green or dark-brown in color, are brittle and easily removed from a surface by scraping with the finger nail. They can be washed off with water, though not water soluble. Because property will frequently appear peppered with spots, bee spots are often mistaken for stains resulting from industrial equipment. Quite often such spotting is severely localized in residential communities far from industrial sources, usually near bee hives, open fields, or commercial apiaries, and in the line of flight between feeding or foraging areas and the hive. Bee spots contain some pollen grains and some beeswax, enough to give the characteristic sweet odor of beeswax when heated over a small match flame on a spoon or pen knife. They may be collected simply by removal with a small spatula or pen knife and sent to the laboratory for analysis and verification.

Oil droplets on property can occur from several sources — from malfunctioning oil wells or pumping and drilling equipment in oil production fields, a refinery itself, high volume oil-quenching operations, and jet and other aircraft, particularly in the vicinity of a heavily trafficked airport. Asphalt droplets may also occur from paving, roofing equipment, or asphalt saturators. Mist droplets form from some types of quench operations where a large volume of material to be tempered has also a high degree of surface area in relation to its bulk. Large quantities of nuts and bolts, for example, will cause vaporization of vapor bath when suddenly immersed in an oil bath at high temperatures. The amount of mist vapor driven off in this type of operation usually requires control equipment.

Another source of liquid particulates arises from the malfunctioning of collection equipment, particularly water scrubbers and wet filters, when particles entrained in the liquid medium on wet walls, impact surfaces, or baffles are ejected into the atmosphere. This may occur accidentally from spray towers, Roto-Clones, and even electrostatic precipitators. Asphalt mists have been emitted from scrubbers and control equipment serving asphalt saturators. Occasionally, mud-like particles are emitted from wet collectors serving sand conditioning equipment in foundries.

C. *Tracking Liquid Particulates*

Because air-borne liquid particulates do not travel nearly as far as do odors, they will generally settle out in the neighborhood close to the source of the mist. This particular property of liquid particulates, taken together with the fact that they can be sampled, is of great assistance in tracking down sources since simple sampling equipment or test panels can be used.

In proving a public nuisance, it is not usually necessary to determine the concentration of the particulate in the atmosphere. But where the source and the particulate are unknown, it may be necessary to collect samples for identification by laboratory analysis. The general methods of tracking unknown sources are described below. Once a suspected source is determined, an analysis of the suspected stack or vent can be requested.

Where the source is unknown, an estimation of wind direction may be required. This may be accomplished by a study of paths of deposition. If one side of an automobile or house is habitually contaminated, the wind direction may be inferred. The interview with the complainant should attempt to establish, if possible, the wind direction at the time of contamination. If this is impossible, the inspector should attempt to establish the time the contamination took place, so that he can inspect the premises to determine wind patterns for himself. In complex cases involving heavily industrialized communities with many possible sources, or where contamination does not appear to be localized according to wind direction, the inspector should plot a wind rose showing the direction from which the winds came, the time intervals, and the relative intensity. This information then can be used to plan reinspections and to determine the possible location of test panels should they be required.

Most sources of liquid particulates can be located by downwind tracing of trail of fallout, or areas of contamination. If the contaminant has been identified, a given source may be shown to exist if the contaminated area is within the probable range of travel or fallout of the air contaminant, if the air contaminant is observed or detected emitting from the source in such quantities as to make contamination in the affected area probable, and if no other sources can be accounted for.

Once a plant is suspected, roof areas adjacent to stacks and vents should be observed for stains, coatings, and other deposits which have accumulated. The extent of the damage, and the degree of deterioration, decay, erosion, or general filth on the deposited material should be compared with the total time the equipment or process has been in use, and that compared, if possible, with the extent of recent damage. The overriding path of such deposition should also indicate the general direction contaminants have traveled in the atmosphere, and can be lined up with the "target" or complaint area in the community. A photograph of such deposition on roofs or other structures should be taken whenever possible.

If the source is unknown or a number of possible sources exist, or if the air contaminant is not readily identifiable, then any of the following procedures may be used:

1. Identification of the Air Contaminant Is Needed Only

There are two general methods for collecting aerosols for identification. One of these is the use of fall-out jars, with a known area of opening. The jar is filled half full with distilled water and is stationed at a location selected after analysis of the wind rose. After a specified period of time, the jar is picked up and brought to the laboratory. An aliquot of the sample, i.e., a known fraction of the solution, is evaporated to isolate the soluble and insoluble portions. These are then tested either for a suspected material (such as phosphates, sulfates, iron oxides, silica, any of the acids, etc.) or a qualitative analysis is run. The quantity of the material determined is then multiplied by the number of fractions, or aliquots contained on the basis of the initial fraction selected, and is averaged over the area of the opening. Thus, not only the particle identity, but an indication of the amount of fallout of the suspected contaminant in the immediate area is given.

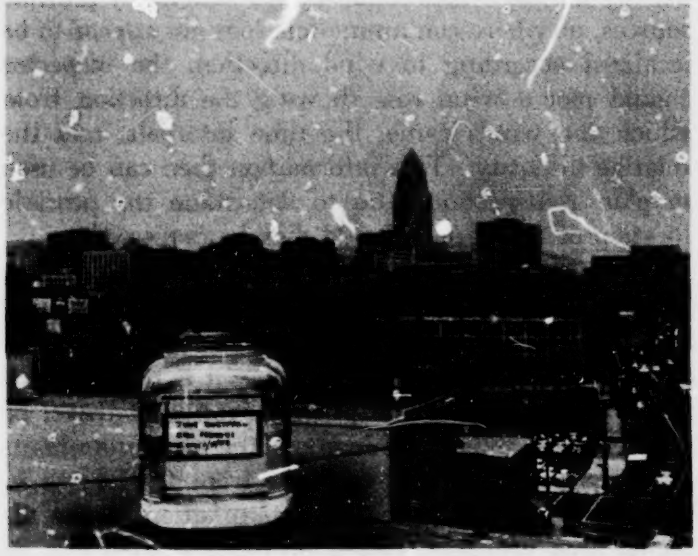

Figure XII - 9. Dust-fall jar.

The second method is the use of a panel consisting of either a porcelain or other smooth non-reactive metal about one foot square coated slightly with petroleum jelly or an absorbent type panel paper. The former is generally preferable for the collection of solid particles or particles resulting as a solid residue. The absorbent paper is generally preferable for acid mists, paint spots, or any substance which will be absorbed by the paper. Tests made of materials in petroleum jelly, however, are uncertain due to chemical interference and the possible reactivity of the jelly. In the case of the absorbent paper, the possible chemical constituents which might interfere or be mistaken in the analysis should be determined independently.

Whenever the contaminant can be sampled directly from the atmosphere, and a substantial sample is needed for positive identification, any of several types of portable aerosol sampling equipment can be used. These are generally of the filter, impinger, inertial separator, or electrostatic types (see Figures XI-3 and XI-10G) and are either powered by aspirators or pressure pumps. A known volume of air is passed through each such device, and the sample collected is extracted for qualitative or quantitative analysis for identification.23)

When such field tests are made, the inspector accurately determines the time, date, interval of testing, wind direction, distance from source, and any other pertinent information. The samples of contaminants collected are then brought to the laboratory for analysis.

2. Proof Is Needed of Contribution from a Suspected Source

Assuming that the contaminant is known, and a source is suspected with some certainty, a method may be required for providing demonstrative proof. Test panels (either of the paper or metal type) may be placed in a path downwind from the source ranging from the contaminated area to the equipment suspected. The panels should all be of the same size. If the frequency of contamination of panels increases as the distance to the suspected source decreases, then the evidence may indicate that the source in question is the actual offender. Inclusive dates and times of exposure, distance of individual panels from the source and any other conditions of testing should be shown on the report.

3. The Identity of an Unknown Source or Sources Needs to be Determined

If no specific source is suspected, or more than one source is possible, a major investigation may be required. This is accomplished by coordinating the activities of several inspectors, particularly if the damage from contaminants is serious and widespread. An effort will be required to determine the boundaries of the damage in order to establish the range of travel. Once that is established, inspections of industrial facilities can be concentrated in the suspected area. At the same time, a thorough analysis of the contaminated area should be conducted. The following should be determined from observation, testing and interview:

a. Frequency and time of day contamination takes place.
b. Length of period of contamination.
c. When contamination was first noticed.
d. Prevailing wind patterns for the area.

In complex cases a sketch or map should be drawn including the above information and indicating:

a. All possible plants, equipment and their distances from contaminated area.
b. All areas affected, with notation as to which areas are most frequently affected, and their distances and directions from suspected sources.
c. Pertinent addresses, such as point observations and complainants.
d. Location of test-panel or fallout jar stations.

When fallout jars or test panels are necessary, they may be posted or stationed in the following manner:

a. On or near contaminated objects, such as automobile or house-sidings.
b. If necessary, in 360° circle around contaminated area to determine the path or trajectory of the contaminant unless an inspection of the contaminated area already discloses the general pattern of deposition.
c. Posting of one or more panels horizontally or stationing fallout jars as an indication of general fallout since some contaminants may travel long distances.
d. Posting panels or stationing jars in possible lines of travel of contaminants from suspected source.
e. Panels or jars should be systematically numbered and should show dates of exposure. Exposure may be expressed in terms of hours, minutes, or days.

f. Panels and fallout jars should be stationed and removed in a manner which will show time of day contamination takes place. The pattern for change may be based on a study of the wind movement for the area.

In evaluating data compiled by employing the above procedures, the inspector may feel assured that he has reasonably substantiated his case, provided the following are true:

a. A series of panels downwind from the plant shows increase in deposition per unit area over a decreasing distance to source.
b. If other panels testing other sources in the vicinity show little or no spotting.
c. If the contaminants on the complainant's property, test panels in series, and adjacent to source are chemically identical.
d. If the suspected equipment emits the contaminant in question during exposure period of test panels.

When the above evidence is gathered, the source should be contacted and the findings explained. In many cases in which management is convinced it is responsible, voluntary remedies may be instituted.

With respect to stains resulting from liquid particulates, a check should be made of possible violations of maximum permissible emission Rules 52, 53, or 54.

Where management refuses to correct the problem, a Section 24243 Public Nuisance Notice may be issued and District Attorney forms completed and signed by complainants. Complainants must be willing to testify in court. All District Attorney forms should be made out by the complainants in their own handwriting.

Where the source was originally unknown, the complainants should be prepared to testify that a nuisance exists after the inspector has explained that he has accurately identified the source.

Where multiple sources exist, legal action can be taken simultaneously.

IV SOLID DEPOSITS

By deposits we refer specifically to particles of solid materials which settle out of the atmosphere or impact on surfaces. These are fine materials which are substantially in excess of one micron in diameter and have a relatively fast settling rate, such as dusts, ash, minerals, grains, powders, flour, etc., and are large enough to be seen with the naked eye. Small invisible particulates do not generally enter into complaints, unless they react chemically with surfaces to form visible stains, abrasions or pittings. Complaints made against deposits concern the littering, soiling qualities of deposits, and the time and expense required to keep property free of them. Deposits may also contaminate materials such as clothing and silk stockings, or enter into commercial or industrial processes as impurities. For this reason one industrial plant might complain of another about the contamination of its product by dusts or solid particles. Occasionally complaints are received concerning the chronic contamination of swimming pools from fly ash or soot from incinerators or boilers located nearby. Such deposits frequently collect in rain gutters, window sills, sidewalks, porches, curtains and clothes.

The sources of solid deposits are extremely numerous. Dust is created by almost every commercial, domestic and industrial activity. Dusts are produced wherever materials are ground, pulverized, crushed, destroyed, scraped, milled, conveyed, etc. Deposits entering into significant complaints and public nuisances, however, most likely originate from the "dusty" industries, i.e., wherever dusts, grains, minerals, and other solid particles are either manufactured or handled in large volumes, or evolve as production waste. The "dusty" industries include grain and feed mills, mineral processors, fertilizer plants, pottery and ceramic manufacturing, hot asphalt and concrete batch plants, cement manufacturers, the roofing industry (mica, talc and crushed rock), woodworking industries (sawdust) and others. Handling and production equipment found in these industries include hammermills, pulverizers, crushers, bagging machines, shaking, classifying and grading devices, batching equipment, bucket elevators, air conveyor systems, aggregate dryers, loading hoppers and scales, sanding equipment, shot blast booths, etc.

Dusts or solid particles are controlled according to the size and volume of the particles involved, the efficiency of control being dictated both by production requirements and A.P.C.D. law, specifically Rule 54, Dusts and Fumes. The finer the material, the greater the collection efficiency required. For example, dusts from rock crushing, ore handling, woodworking, sand conditioning, etc., in the range of 5 to 200 microns can be handled satisfactorily by a centrifugal collector. Water scrubbers are capable of handling fines in the nuisance range, but their efficiency is generally dependent upon high grain loadings and soluble contaminants. The most efficient and perhaps versatile of control devices is the baghouse, which is capable of achieving collection efficiencies close to 100%. In the case of asphalt mixes, which range in Los Angeles County from a low of 2 per cent minus 200 mesh material, to a high of 12 per cent minus 200 mesh material, collection efficiency of control devices must range from 95 per cent to more than 99 per cent. This can be met by a cyclone separator followed by an efficient type of water scrubber such as a multi-pass type or a wet-wall multiple cyclone.

Regardless of the efficiency of control devices, dust emissions should be checked particularly at the dissipation point of steam plumes (see Chapter 10). Leaks in hoods and conveyor systems should also be checked for emissions. Dust emissions may not only violate Rule 54 (dust loading), but also Rule 50, should opacities exceed 40%. When a nuisance complaint is registered against a dusty industry, the inspector generally inventories all of the equipment on an Equipment List (see Chapter 14) and makes a flow chart to check out all possible points of dust emission.

The methods employed for tracking solid particulates from unknown sources are the same as those applied to liquid particulates, discussed previously. Solid particles, however, are more readily traceable due to the trails, drifts or piles they tend to leave on the ground.

Where no immediate source is apparent in the community, the inspector may be required to look for large sources located at considerable distances from complainants, such as steam-generating plants, ships, industrial incinerators, etc., especially when such dusts can be carried by strong prevailing winds, usually incoming shore breezes near the coast. A study of the micrometeorology of the area, as with odors and stains, will help locate a probable source area. Test panels with a slight coating of petroleum jelly may be used for tracking purposes.

The sample of the dust collected on complainant's property may be used both as the sample for analysis, if necessary, and as evidence. Its trail may be traced to a source on the ground or through observation of plume.

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CHAPTER THIRTEEN

COLLECTING AND REPORTING EVIDENCE OF VIOLATION

Virtually all of the inspection techniques described in this manual are employed primarily towards one end — the collection of data and evidence. In fact, all data collected by inspectors are of an evidentiary nature. Evidence of compliance is as important as evidence of violation. Data collected on surveys and inventories are evidence which can be used in determining future enforcement policy. Whatever form the data take, they will always consist of facts and findings acquired, primarily, through the inspector's direct senses, and reported and stated in such a manner as to be clear of prejudices and other subjective factors.

The data collected by the inspector is written down on a report form. The written report, however, is not in itself the evidence that is normally used in a court of law to prove a case. The evidence compiled by inspectors consists primarily of *testimonial evidence*, when the inspector testifies to the facts obtained from his observations and inspections, and *expert opinion*, when he testifies to the observations of excessive emissions he observes. Physical or demonstration evidence, such as photographs, samples of fuels, etc., are also used in air pollution control cases. The written report may not actually appear in court proceedings, though it may be used to refresh the inspector's memory.

I ESTABLISHING THE PRIMA FACIE CASE

To provide a sufficient basis for court prosecution, the field inspector must gather the evidence essential to establish a *prima facie* case — that is, a case, which unless rebutted, adds up to the commission of a violation of an A.P.C.D. Rule or Regulation by the defendant. Each and all of the individual elements of the crime, (in legal terminology, the *corpus delicti*) must be proved. Thus, if the prohibition is that "a person shall not discharge into the atmosphere from any single source . . . any air contaminant" of any particular quality for more than the maximum permissible time specified, it must be proved that: (1) a person (2) discharged (3) into the atmosphere (4) from a single source (5) a contaminant (6) of the quality proscribed (opacity or density) (7) for more than the time specified.

If any of the required elements is absent, for example it was not a single source, the corpus delicti is not established and there is no case.

In some instances, in order for there to be a violation, there must have been knowledge or intent on the part of the defendant. This is known in legal terminology as "scienter".

Most prohibitory air pollution regulations do not require scienter, but impose "strict liability" upon the defendant. This means that "I didn't know the stack was smoking" is not a defense any more than "I didn't realize I was going that fast" is a defense for speeding.

In order to establish a prima facie case and to meet the requirements for reporting the air pollution "configuration" described in Chapter 9, the following information must be reported by the field inspector for each violation[*] observed.

1. The nature and extent of the violation.
2. The time and location of the violation.
3. The person(s) responsible for the violation.
4. The equipment involved with the violation.
5. The operational, design or maintenance factors which caused the violation.

Each of these elements, in turn, requires a sufficient degree of documentation before the violation can be established. The courts require adequate proof of all five of the above before conviction can be obtained.

It should be noted that even when a specific act affecting the emission of air contaminants or air pollution rules is attended by all of the elements of a crime discussed in this section, an actual violation does not exist if the act is specifically exempted from the provisions of the Rules and Regulations or is covered by a variance. The legal authority usually makes certain detailed exceptions of equipment or acts which need not comply. For example, in Los Angeles County, Section 24245 of the State Health and Safety Code prevents the District from taking any criminal action against publicly owned facilities. Section 24245 and 24251, agricultural operations, specifies conditions under which violation of Section 24242, smoke and opacity, are permissible. Detailed exemptions are also made with reference to the permit requirements, such as Section 24265 and District Rules 11 and 13.

A. The Nature and Extent of the Violation

This element of the violation requires that the inspector determine the exact Rule which has been violated by any specific type of air pollution problem. The inspector, therefore, must be thoroughly familiar with all of the Rules he may enforce in the field. These fall into six categories: (1) excessive emissions (all maximum permissible emission standards, including public nuisance), (2) unauthorized construction or operation of equipment, (2) uncontrolled equipment, (4) bans, (5) noncompliance with alert instructions, and (6) noncooperation and circumvention.

The severity or extent of the violation must be determined before a violation can be demonstrated. The "extent" of violation refers to the degree of air pollution measured in terms of the specific standard in the rule, or the extent of non-compliance with the phrasing of the prohibition in the rule. Most Rules stipulate a single standard of compliance. The "extent" in a Section 24242 smoke or opacity violation, for example, is measured in terms of the Ringelmann standard. In a 24279 violation, unauthorized construction of equipment, the extent is determined according to the date construction took place and the degree of completion.

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[*] Under Sections 24253 and 24281, any violation of the Health and Safety Code or the Rules and Regulations is a misdemeanor and each day the violation occurs constitutes a separate offense.

The fact that a violation is observed, must be accompanied, in the report, by the methods used to measure the extent of the violation. The procedures used in making visual determinations must be accurately recorded. For example, each Notice of Violation issued for a Section 24242, smoke or opacity violation, requires the following data to confirm accurate use of the approved smoke reading method (see also Figure XIII-1):

1. Point of observation from source.
2. Weather conditions during observation.
3. Wind direction.
4. Visible emissions observed showing continuous time intervals for each opacity and density, color change, and total violation time in minutes.
5. Status of plume at end of recorded observation.

A Notice of Violation issued for invisible contaminants should be accompanied by the test results and procedures used by the source testing team.

B. The Time and Location of the Violation

The exact date and time the violation occurred is also a necessary element. The time of violation is generally noted in terms of (1) the time the inspector arrived and the time he departed from the scene to investigate the violation, and (2) the specific time period or time intervals of the violation.

The time of violation usually is noted within the "Arrival" and "Departure" times, although, in instances where reinspections are necessary, the last inspection stop made may be a date and time occurring after the violation was observed. The written Notice contains a specific blank for inserting the "Arrival" and "Departure" times. The Inspector's Field Report (see Figure VII-7) provides blanks for showing the total elapsed time of the inspection and the total time spent at the source, to differentiate between the time spent in conducting the physical inspection of the premises and the time spent in writing the report, interviewing complainants, and other related investigative work.

The location is the actual address at which the violation was observed, the "RE PREMISES AT:" blank on the Notice of Violation. The address must be given in terms of number and street. If the number is not known or available, the block number may be used with the street name. The street name must be given in full (including "Ave.", "Rd.", "Dr.", "Pl.", "Blvd.", etc.).

The city or community name must be that of the post office delivering mail to the location. Should the location of the violation be in unincorporated territory, the post office or other legal designation must be used.

The location of the violation for moving sources should be described as follows:

a. Ships — the berth and the harbor.

b. Locomotives — the street on which the inspector observed and followed the train and the intersections and cities where observation began and ended, as well as the direction traveled.

c. Vehicles — the actual location of the violation is important, since the court jurisdiction is based on that location where the inspector completes his observation of the excessive emissions. The location includes the street on which the vehicle was followed and the intersecting streets at which the observation began and ended. The initial and terminal communities involved should be included as well as the proper court jurisdiction.

C. The Persons Responsible for the Violation

Rule 2b includes under the term "Person" any person, firm, association, organization, partnership, business, trust, corporation, company, contractor, supplier, installer, user or owner, or any state or local governmental agency or public district or any officer or employee thereof.

The "Persons" include all individuals responsible for the equipment by reason of legal operations and all individuals who may be responsible for the specific act which resulted in the violation. The persons generally associated with the violation will consist of the owners of the company, and the employees immediately responsible. Court action in most cases is filed against the owners of the company, and sometimes against both the owners and the employees immediately responsible for the operation of the equipment, depending on the circumstances. In all investigations of violations, the inspector must report the name of the company, its form of ownership (company, partnership, individual, corporation, etc.), the highest authority contacted, and the name and description of the employee or person operating the equipment at the time of the violation. The association of all persons involved, such as employee-employer relationship, etc., may be determined by direct interview.

The steps by which the persons responsible are established, follow. The data should be written in the appropriate blanks of the Notice. (See the Written Notice of Violation, Figure XIII-1.)

a. Obtain the name and title of the person in highest authority contacted.

b. Obtain the name of the firm or the person (include full name and middle initial) owning or leasing the equipment. If the equipment is leased, the lessee is responsible. The name of the company should be designated as one of the following, whichever is appropriate:

(1) Corporate Name—"Smith Products, Inc."

(2) Registered Fictitious Owner—John Doe and Richard Roe, dba "Rough and Ready Co."

(3) Individual Owner—"Joseph P. Doaks (Apts.)"

(4) Proper Name Used Only —
"Judson R. Smith (Apts.)"
"John Doe (Contractor)"
"Sam Brown (Private Residence)"

(5) Division of Corporation —"Midwest Steel Corp. (Pacific Coast Division)"

(6) Subsidiary — Subsidiary corporate name alone may be used.

(7) Sole owner or partner — Show first and last names of owners doing business as a certain company, such as "William Blake, dba Tiger Upholstery Company." The names of other partners should be listed under the "Findings" portion of the Notice.

(8) Management Companies — Both the names and the addresses of the management company and the legal owner should be supplied. The report should be titled according to the name of the activity at the source.

(9) Driver's Identification (Vehicle) — Driver's full name, residential and business addresses, operator's or chauffeur's no., the license number and state issued, and other identifying data acquired from the driver's license.

(10) Vehicle Identification — Registered owner and address, license no., make, body type, cab no. of tractor, state licensed.

(11) Locomotives—Railroad line and engine no.

(12) Ships — Name painted on either side of bow. Nationality, determined by flag at stern. Name of home port, usually across the stern. Legal owner and official number located on ship's document on board American coastal ships or at the United States Customs Office, Federal Building, San Pèdro, in the case of foreign ships from foreign ports of origin.

c. Obtain the address where the business affairs of the company are conducted, i.e., the mailing address. This address will sometimes differ from the address at which the violation occurred. In cases where the owner (corporation or individual) uses an address other than the business address shown, that address should also be shown.

d. Enter phone number of the owner or business.

e. Obtain the title, name and address of the person actually carrying out the operation involved in the violation. If possible, his automobile license number should be obtained for positive identification. The individual's connection with the firm and his relation to the operation involved should be determined by questioning that person to determine whether or not the operation being carried out was a part of his normal duties. The interview should also disclose the name and title of the person from whom the employee takes his orders.

f. Statements are next recorded on the "HIS REMARKS" section. These are the remarks made by management and employees which are pertinent to the elements of the crime. These will include verification of ownership status, employer-employee, manager-owner or tenant-owner relationships; permit status of equipment, practices of management in regard to air pollution prevention, the cause of the violation, knowledge of the law, etc., and any other information related to the violation.

D. *The Equipment*

The cause of the violation is ascertained from the physical inspection of the source of emission or the equipment involved in the violation. The first important step in determining the cause of [illegible] violation is the location of the specific piece of equipment responsible. Equipment may be traced from the stack or ductwork, observed directly as the source, or deduced through a process of elimination as the only possible piece of equipment capable of producing the plume observed. In other cases, the responsible piece of equipment may occur as one among several possible pieces of similar or identical equipment. In these cases the inspector observes plant conditions closely for those operating cycles which result in excessive emissions. Excessive emissions observed inside of the plant from equipment, it should be noted, can be reported as violations, although, as a matter of administrative policy, this is not done.*

The identification of the equipment consists of constructing a verbal description which positively identifies the source as a specific class of equipment capable of air pollution. The identification must do two things: (1) It must distinguish the exact piece of equipment from among all other equipment in the plant, and (2) it must describe all of the important constituents of the equipment which affect the generation of pollutants, or which possibly qualify the permit status of the equipment. Below are listed some guide points which can be used in identifying equipment.

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* Rule 2n. "'Atmosphere' means the air that envelops or surrounds the earth. Where air pollutants are emitted into a building not designed specifically as a piece of air pollution control equipment, such emission into the building shall be considered an emission into the atmosphere."

1. The number of equipment units taken as the single source.
2. The function or application of the equipment.
3. The class or design category of the equipment, or the process in which it is used, or the materials fed, if these are pertinent to a positive identification.
4. Size, charge or feed capacity of equipment, if these are pertinent.
5. The commercial name of the equipment and the manufacturer's serial number, if any.
6. Plant's equipment location number or relative or approximate location of equipment within the plant
7. Important equipment appurtenances which would qualify its permit status, such as type of heating element, blower motors, etc., together with manufacturer's name and serial number.
8. Other equipment serving or served by the equipment identified as the source.
9. Description, manufacturer's name and serial number of all control equipment involved.

Examples of four types of source descriptions are listed below. The numbers in parentheses refer to the numbered guide points above.

a. One (1), Horizontal Return Type (3), Smith Iron Works, Serial No. 2345 (5), eastmost of two (6), Boilers (2), served by 2 Ray Rotary Cup oil burners, Serial Nos. 2000-1, 2000-2 (7). Both boilers are breeched to a common 4-foot diameter x 30-foot high stack (8). Westmost boiler not in operation at this time.
b. One (1), open fire (2), 5 feet diameter x 3 feet high (4), consisting of eucalyptus tree cuttings, tar paper, creosoted number, rubber tires, oil rig timbers and paint cans(3).
c. Three (1), 350-pound (4), yellow brass, hydraulic tilt (3), melting furnaces (2), venting directly through one roof monitor, 20 feet long x 3 feet wide (8). Melt contains 14% zinc, poured at 2200°F. All furnaces in full operation at this time.
d. One (1), Local Blower Exhaust System (2), XYZ Pipe (5), ductwork, 24 inches diameter, 15 H.P. blower capacity (4), served by one 3-foot diameter cyclone (9), and serving four belt sanders, one sticker, one tenoner, two planers, and one cross-cut saw (8). Only the belt sanders were in operation at this time.

Although the descriptions of the hundreds of different types of equipment vary considerably, the above four examples are sufficiently typical to illustrate the elements necessary in the proper description of the source of emission, or the equipment involved in the violation. As will be noted, the identification may also include those design, process or operational characteristics which affect the air pollution problem. The notations of the brass furnaces include, for example, the amount of zinc melted and the pouring temperature. Also, in this example, the entire roof monitor is taken as the source and the important notation that all three furnaces are in operation at the time of observation is included. The findings may also include observations of emissions within the plant. In example "d," the list of equipment served by the blower system is important in determining cause, since the notation that only the sanders were operating may indicate that the cyclone is not efficient in collecting sanding dust alone. Similarly, in sample "a," the source is tied to one of two boilers, the eastmost, both breeched to one stack, since the westmost boiler, presumably used for standby purposes, was not in operation at the time of the inspection.

E. *Operational and Maintenance Factors*

The identification of the equipment logically leads to the next step in determining the actual cause of the violation. In some cases, the identification will be sufficient since, for example, an open fire *per se* is a violation of Rule 57, and if excessive smoke is also observed, a violation of Section 24242. In the case of excessive smoke (example "b"), the fact that the fire consisted of such materials which cannot possibly be burned in an open fire without emitting black smoke substantially in excess of No. 2 Ringelmann, the cause of the violation is self-explanatory. In such cases, that aspect of cause which relates to intent and responsibility of persons who ordered and lit the fire are of prime importance.

In more complex cases, however, a more detailed explanation may be necessary. In refinery operations, for instance, schematics of flow processes and material flow with notations of vapor pressures and temperatures, etc., are drawn to locate and estimate the possible losses of vapors and gases. In still other cases, the inspector indicates, where appropriate, whether or not combustion equipment operated at too low or too high a temperature in degrees Fahrenheit, as against normal operating temperatures; whether dampers are stuck, flame ports are blocked, or auxiliary burners for multiple chamber incinerators were firing, etc.

The inspector checks the equipment and determines by interview and observation the actual conditions under which the equipment in question has been operated *during the time of the violation.* The cause of the violation may also be substantiated by statements made by the plant operator under interview, such as declarations regarding equipment failure, maladjustment, poor maintenance, and variation in operating procedures. (See "Operational and Maintenance Practices" Chapter Two). The causes which enter into each of the categories of violation, of course, vary. In establishing unauthorized construction, for example, it is necessary to describe the actual physical status of construction, per cent completion, date construction begun and completed, etc.

In establishing the cause of the violation, demonstration evidence may be gathered such as samples of fuels used, smoky materials burned, metals melted, odorous materials. Photographs can also be taken. As a matter of fact, it is a routine enforcement procedure to photograph visible violations observed.

II REQUIRED EVIDENCE FOR THE VIOLATIONS

The elements of the violation discussed in the previous section are general principles which apply to all violations observed by inspectors in the field. Determining the time, location and the persons responsible for the violation is virtually the same for almost every violation. Obtaining evidence for determining the nature, extent and the cause of the violation, however, varies somewhat according to the Rule being enforced and the air pollution problem encountered at each source. The additional evidence which must be collected to substantiate the individual categories of violations will now be considered. In some categories, the primary evidence is obtained by the techniques used to identify and evaluate source emissions, which were treated separately for study in this manual.

A. Excessive Emissions

1. Section 24242, Smoke and Opacity

a. Stationary Sources

For excessive emissions of smoke, fumes and other contaminants, the accurate use of the approved smoke reading method as described in Chapter Ten, "Reading Smoke in the Field," must be shown on the report or notice. This will include not only an accurate recording of each reading and the time intervals, but the following as well:

1. Point of Observation: Direction and distance of observer from the source, or the actual location of the observer. If the exact location is not known, the approximate distance can be given.
2. Weather: Designated as "clear," "overcast," "cloudy," "rainy" or "hazy"
3. Wind: The direction from which the wind blows, recorded by circling the appropriate designation on the Notice. If no wind is present, this fact should be indicated. If the wind changes direction, all directions and the time of change are noted.
4. End of Observation: Check "yes" or "no" to indicate whether source was emitting visible discharge at end of observation. Note last recorded opacity or Ringelmann Number here. This indicates the time at which the observation recorded on this Notice was completed.
5. Emission From: Circle appropriate source, BASIC, CONTROL or OPEN FIRE.

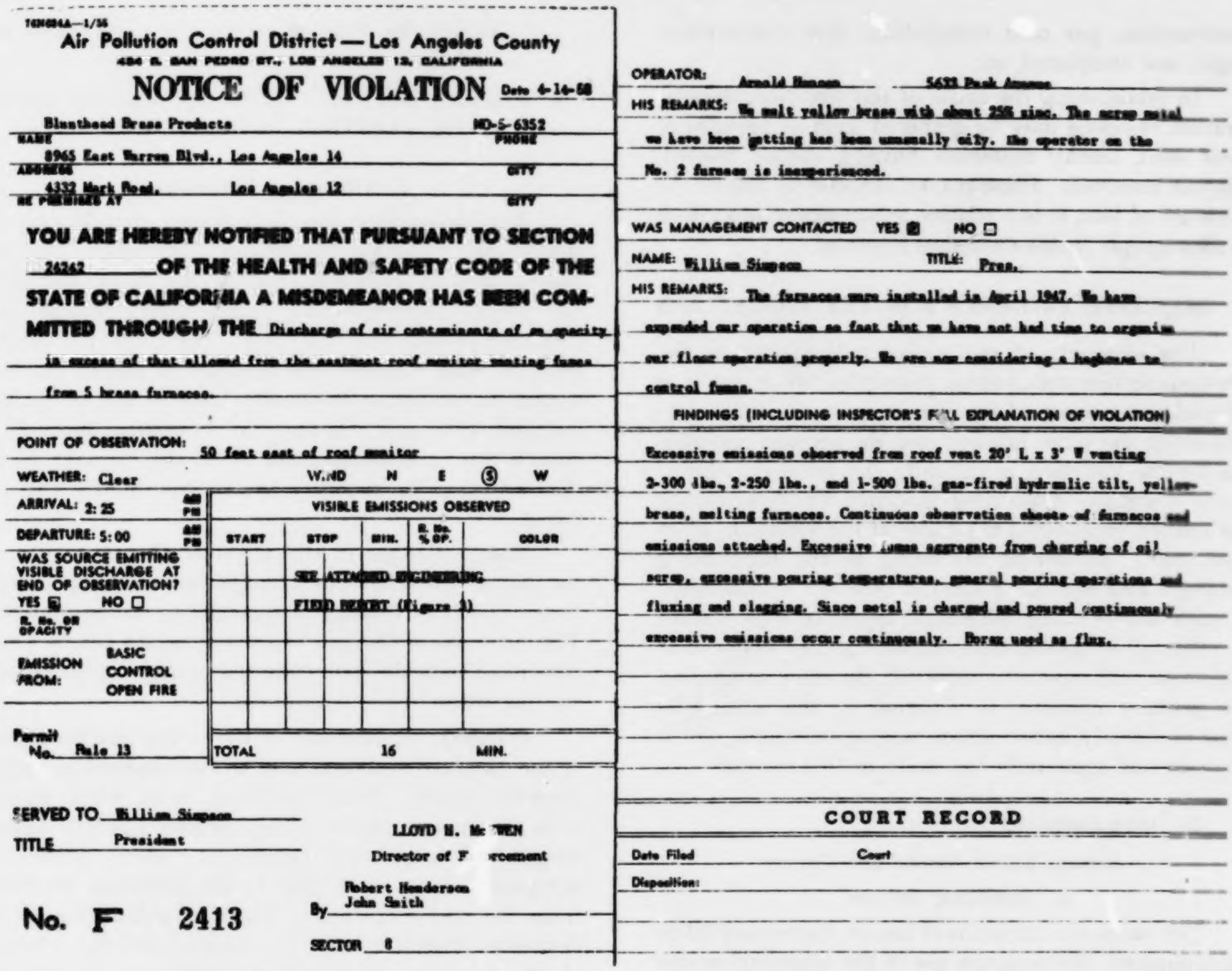
1. Observing Emissions

The observation of the emission should not be interrupted. During the observation period, the inspector should study the emission carefully, and note the periods during which plume colors change and densities or opacities fluctuate. The inspector should note, as well, whether the volumes of smoke emitted appear to consist of unusually large quantities of air contaminants and whether the emissions fanned or spread over a neighborhood. General remarks as to the reduction in visibility in the community can be noted.

Sharp changes in the physical characteristics of the plume may indicate changes in operating procedures, cycles or feeding of material to the equipment. The times these changes become apparent can be later correlated with the data gathered in making the physical inspection of the equipment.

Problems in determining the source and the cause of the observed violation may be encountered in large, complex plants. These problems arise when plants with numerous pieces of equipment operate under heightened production conditions. Many pieces of equipment may contribute to the pollution emitting from the roof monitors or stacks of a building. It is desirable, therefore, that the interior and the exterior of the plant be observed simultaneously by two or more inspectors to determine the responsible equipment and the operating conditions which resulted in the violation. In conducting coordinated inspections of this type it is important that the watches of all inspectors concerned be synchronized, and that observations of significant time and cycle factors be accurately recorded.

In conducting a coordinated inspection it is perhaps best to use a continuous observation sheet, such as the "Engineering Division—Field Report" for the opacities or densities of visual emissions observed outside of the plant. The continuous observation sheet can be appended to the report or violation notice form. Changes in the plume characteristics can also be noted on this form. Another continuous observation sheet can be designed on-the-spot by the inspector for recording operational data inside of the plant. Such sheets are designed to obtain the precise types of data desired from the physical inspection. A sample observation sheet which might be used for a non-ferrous foundry is shown in Figure XIII-2.



76N684A—1/56

Air Pollution Control District — Los Angeles County

434 S. SAN PEDRO ST., LOS ANGELES 13, CALIFORNIA

NOTICE OF VIOLATION Date 4-14-58

Name: Blunthead Brass Products — Phone: MO-5-6352

Address: 8965 East Warren Blvd., Los Angeles 14 — City

Re premises at: 4332 Mark Road, Los Angeles 12 — City

YOU ARE HEREBY NOTIFIED THAT PURSUANT TO SECTION 24242 **OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA A MISDEMEANOR HAS BEEN COMMITTED THROUGH THE** Discharge of air contaminants of an opacity in excess of that allowed from the eastmost roof monitor venting fumes from 5 brass furnaces.

POINT OF OBSERVATION: 50 feet east of roof monitor

WEATHER: Clear — WIND N E [✓ S] W

ARRIVAL: 2:25 AM PM

DEPARTURE: 5:00 AM PM

WAS SOURCE EMITTING VISIBLE DISCHARGE AT END OF OBSERVATION? YES ☒ NO ☐

R. No. OR OPACITY

EMISSION FROM: BASIC / CONTROL / OPEN FIRE

Permit No. Rule 13

VISIBLE EMISSIONS OBSERVED

START	STOP	MIN.	R. No. % OP.	COLOR
SEE ATTACHED ENGINEERING				
FIELD REPORT (Figure 2)				
TOTAL		16		MIN.

SERVED TO William Simpson

TITLE President

LLOYD N. Mc WEN

Director of Enforcement

By Robert Henderson / John Smith

SECTOR 8

No. F 2413

(Front)

OPERATOR: Arnold Hansen — 5633 Park Avenue

HIS REMARKS: We melt yellow brass with about 25% zinc. The scrap metal we have been getting has been unusually oily. The operator on the No. 2 furnace is inexperienced.

WAS MANAGEMENT CONTACTED YES ☒ NO ☐

NAME: William Simpson — TITLE: Pres.

HIS REMARKS: The furnaces were installed in April 1947. We have expanded our operation so fast that we have not had time to organize our floor operation properly. We are now considering a baghouse to control fumes.

FINDINGS (INCLUDING INSPECTOR'S FULL EXPLANATION OF VIOLATION)

Excessive emissions observed from roof vent 20' L x 3' W venting 2-300 lbs., 2-250 lbs., and 1-500 lbs. gas-fired hydraulic tilt, yellow-brass, melting furnaces. Continuous observation sheets of furnaces and emissions attached. Excessive fumes aggregate from charging of oil scrap, excessive pouring temperatures, general pouring operations and fluxing and slagging. Since metal is charged and poured continuously excessive emissions occur continuously. Borax used as flux.

COURT RECORD

Date Filed — Court

Disposition:

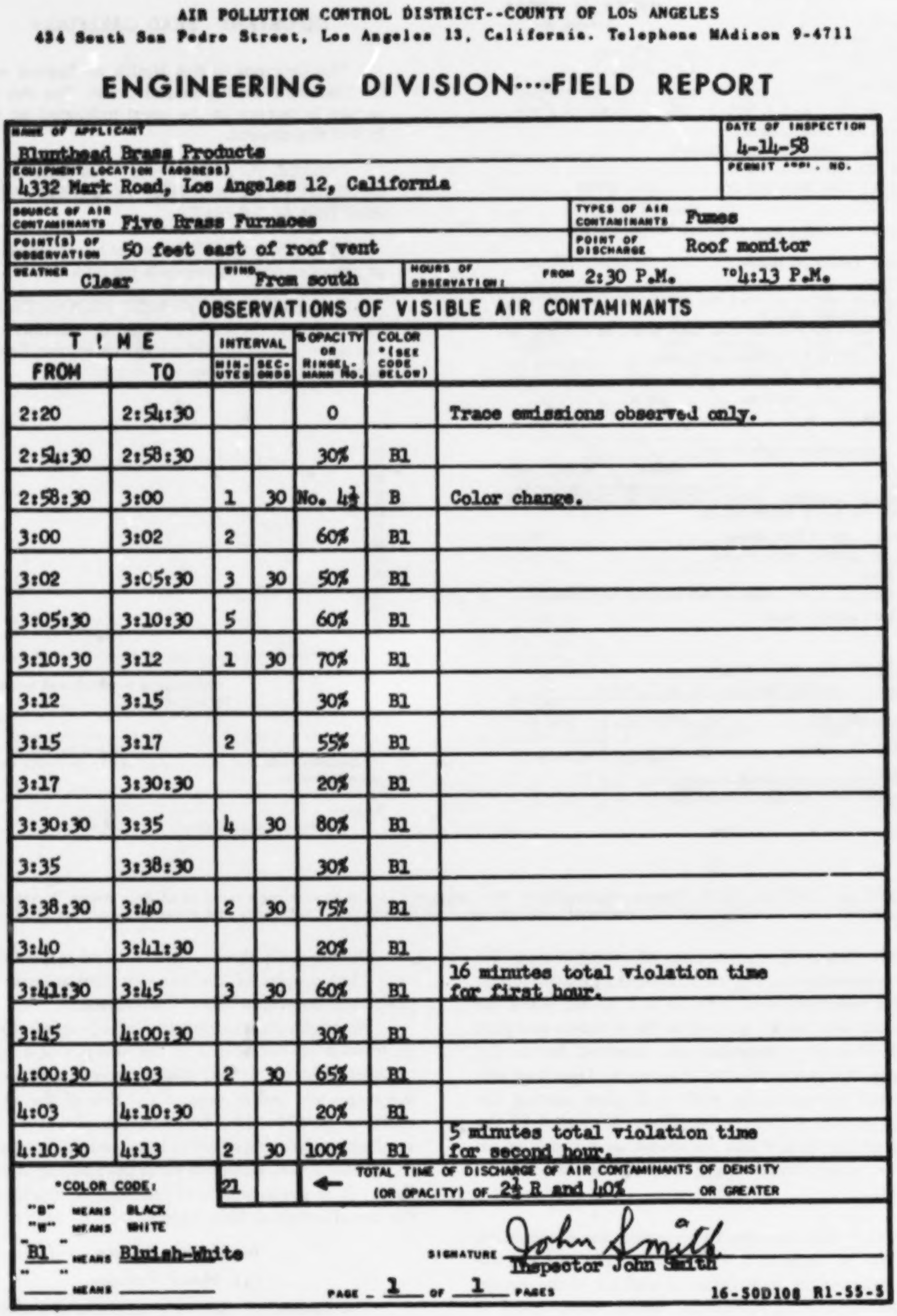
(Back)

Figure XIII - 1. Notice of violation written for excessive fumes from 5 brass furnaces.

FURNACE NO. FROM EAST TO WEST AND CAPACITY	1 300#	2 300#	3 250#	4 250#	5 500#
Light-off	2:30	2:25	2:20	2:32	2:36
Charge	3:01	2:58	2:54	3:05	3:10
Quantity	40#	50# (oily)	45#	38#	40#
Time	3:25	3:15	3:10	3:30	3:35
Max. Temp.	2225°	2500°	2300°	2230°	2230°
Flux added	3:28	3:18	3:13	3:33	3:38
Slagging	3:30	3:27	3:16	3:45	3:50
Pouring	3:41	3:38	3:30	4:00	4:10

—By Inspector Robert Henderson

Figure XIII - 2. Continuous observation sheet for five brass furnaces.



AIR POLLUTION CONTROL DISTRICT--COUNTY OF LOS ANGELES
434 South San Pedro Street, Los Angeles 13, California. Telephone MAdison 9-4711

ENGINEERING DIVISION....FIELD REPORT

NAME OF APPLICANT: Blunthead Brass Products
DATE OF INSPECTION: 4-14-58
EQUIPMENT LOCATION (ADDRESS): 4332 Mark Road, Los Angeles 12, California
PERMIT APPL. NO.:
SOURCE OF AIR CONTAMINANTS: Five Brass Furnaces
TYPES OF AIR CONTAMINANTS: Fumes
POINT(S) OF OBSERVATION: 50 feet east of roof vent
POINT OF DISCHARGE: Roof monitor
WEATHER: Clear
WIND: From south
HOURS OF OBSERVATION: FROM 2:30 P.M. TO 4:13 P.M.

OBSERVATIONS OF VISIBLE AIR CONTAMINANTS

TIME		INTERVAL		% OPACITY OR RINGELMANN NO.	COLOR *(SEE CODE BELOW)	
FROM	TO	MINUTES	SECONDS			
2:20	2:54:30			0		Trace emissions observed only.
2:54:30	2:58:30			30%	Bl	
2:58:30	3:00	1	30	No. 4½	B	Color change.
3:00	3:02	2		60%	Bl	
3:02	3:05:30	3	30	50%	Bl	
3:05:30	3:10:30	5		60%	Bl	
3:10:30	3:12	1	30	70%	Bl	
3:12	3:15			30%	Bl	
3:15	3:17	2		55%	Bl	
3:17	3:30:30			20%	Bl	
3:30:30	3:35	4	30	80%	Bl	
3:35	3:38:30			30%	Bl	
3:38:30	3:40	2	30	75%	Bl	
3:40	3:41:30			20%	Bl	
3:41:30	3:45	3	30	60%	Bl	16 minutes total violation time for first hour.
3:45	4:00:30			30%	Bl	
4:00:30	4:03	2	30	65%	Bl	
4:03	4:10:30			20%	Bl	
4:10:30	4:13	2	30	100%	Bl	5 minutes total violation time for second hour.
		21		← TOTAL TIME OF DISCHARGE OF AIR CONTAMINANTS OF DENSITY (OR OPACITY) OF 2½ R and 40% OR GREATER		

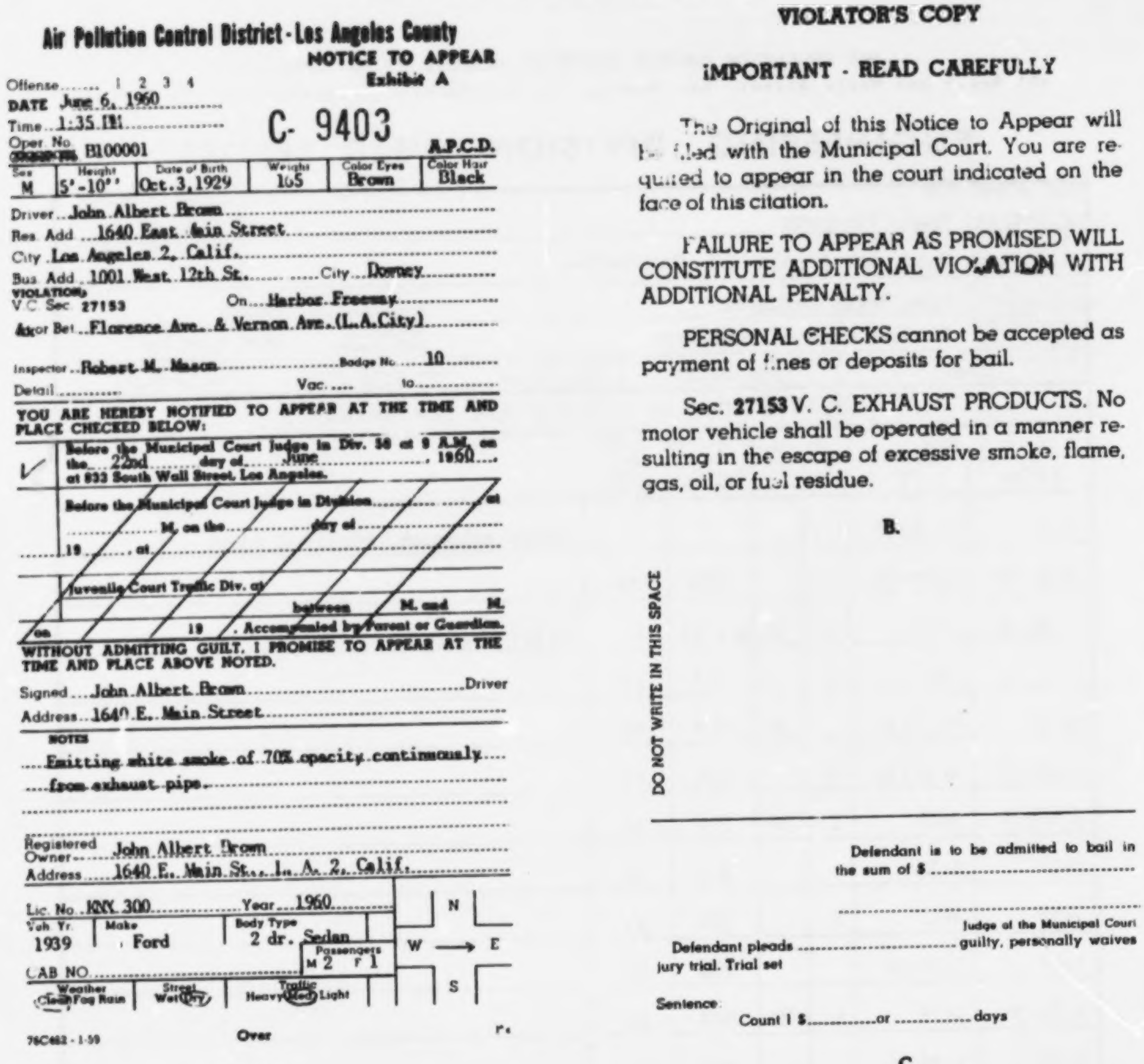
*COLOR CODE:
"B" MEANS BLACK
"W" MEANS WHITE
"Bl" MEANS Bluish-White
"____" MEANS ____

SIGNATURE John Smith
Inspector John Smith

PAGE 1 OF 1 PAGES

16-50D108 R1-55-5

Figure XIII - 3. A.P.C.D. Engineering Division form for observations of visible air contaminants.



Air Pollution Control District - Los Angeles County
NOTICE TO APPEAR
Exhibit A

Offense....... 1 2 3 4
DATE June 6, 1960
Time 1:35 PM
Oper. No. B100001

C- 9403

A.P.C.D.

Sex	Height	Date of Birth	Weight	Color Eyes	Color Hair
M	5'-10''	Oct.3,1929	165	Brown	Black

Driver John Albert Brown
Res. Add 1640 East Main Street
City Los Angeles 2, Calif.
Bus. Add. 1001 West 12th St. City Downey
VIOLATION V.C. Sec. 27153 On Harbor Freeway
At or Bet Florence Ave. & Vernon Ave. (L.A.City)

Inspector Robert M. Mason Badge No. 10
Detail .... Vac. .... to ....

YOU ARE HEREBY NOTIFIED TO APPEAR AT THE TIME AND PLACE CHECKED BELOW:

✓ Before the Municipal Court Judge in Div. 30 at 9 A.M. on the 22nd day of June, 1960 at 833 South Wall Street, Los Angeles.

~~Before the Municipal Court Judge in Division .... at .... M. on the .... day of .... 19 .... at ....~~

~~Juvenile Court Traffic Div. at .... between .... M. and .... M. on .... 19 .... Accompanied by Parent or Guardian.~~

WITHOUT ADMITTING GUILT, I PROMISE TO APPEAR AT THE TIME AND PLACE ABOVE NOTED.

Signed John Albert Brown Driver
Address 1640 E. Main Street

NOTES
Emitting white smoke of 70% opacity continuously
from exhaust pipe.

Registered Owner John Albert Brown
Address 1640 E. Main St., L. A. 2, Calif.

Lic. No. KNX 300 Year 1960

Veh. Yr.	Make	Body Type
1939	Ford	2 dr. Sedan

Passengers M 2 F 1
CAB NO. ....

Weather [✓ Clear] Fog Rain
Street Wet [✓ Dry]
Traffic Heavy [✓ Med] Light

76C482 - 1-59
Over

A.

VIOLATOR'S COPY

IMPORTANT - READ CAREFULLY

The Original of this Notice to Appear will be filed with the Municipal Court. You are required to appear in the court indicated on the face of this citation.

FAILURE TO APPEAR AS PROMISED WILL CONSTITUTE ADDITIONAL VIOLATION WITH ADDITIONAL PENALTY.

PERSONAL CHECKS cannot be accepted as payment of fines or deposits for bail.

Sec. **27153** V. C. EXHAUST PRODUCTS. No motor vehicle shall be operated in a manner resulting in the escape of excessive smoke, flame, gas, oil, or fuel residue.

B.

DO NOT WRITE IN THIS SPACE

Defendant is to be admitted to bail in the sum of $ ....

....
Judge of the Municipal Court

Defendant pleads .... guilty, personally waives jury trial. Trial set

Sentence:
Count I $.......... or .... days

C.

Figure XIII - 4. A.P.C.D. Vehicle Citation quadruplicate: A—Completed face of citation registering on all four copies, B—reverse of the court complaint copy, (the first copy), C—reverse of violator's copy (third copy), A.P.C.D. copy and inspector's copy are identical to the above.

Note that on the continuous observation sheet for visible contaminants, Figure XIII-3, the greatest opacities were observed from 2:54:30 to 3:10:30, when the brass scrap was being charged to the furnaces and that at 2:58:30 a gray emission was observed due to the oily scrap charged to the No. 2 furnace. Opacities also heightened momentarily with each pour during the pouring period, 3:30 to 4:10. From 3:15 to 3:17 the opacity of the fumes also increased as a result of an excessive temperature being reached in the No. 2 furnace.

In this fashion, the two continuous observation sheets can be compared to determine the exact cause of the violation in each instance and all of the equipment and operating conditions which contributed to the generation of excessive emissions.

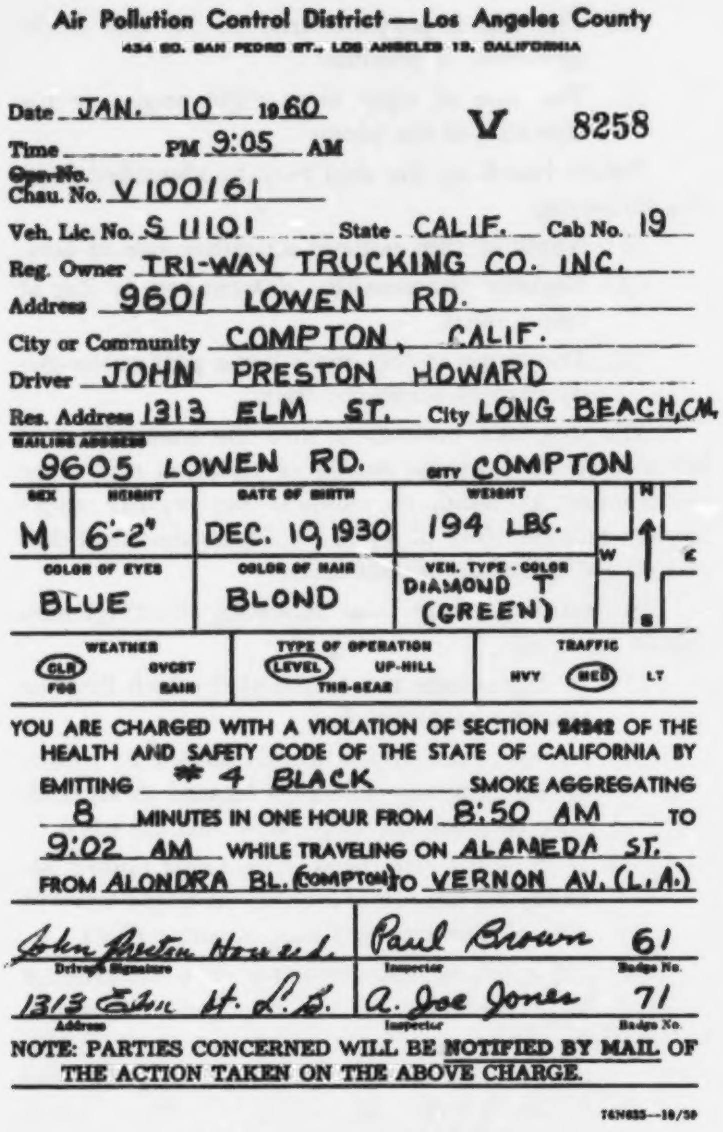
During such observations, a third inspector might take photographs of the exterior and interior of the plant and interview plant management.

For night observations the vehicle spotlight should be trained on the plume in the absence of a sufficient amount of street or moonlight, from a point opposite the inspector, and as near to the line of the observer's sight as possible, i.e., between the observer and the spotlight. This procedure is intended to avoid as much as possible errors resulting from the reading of reflected light. It is preferable that readings be made without the use of artificial light source.

b. Moving Sources

(1) Motor Vehicles

The method of observing excessive emissions from motor vehicles was described previously in Chapter 10,



Air Pollution Control District — Los Angeles County
434 SO. SAN PEDRO ST., LOS ANGELES 13, CALIFORNIA

Date JAN. 10 1960 **V** 8258
Time ______ PM 9:05 AM
~~Oper. No.~~ Chau. No. V 100161
Veh. Lic. No. S 11101 State CALIF. Cab No. 19
Reg. Owner TRI-WAY TRUCKING CO. INC.
Address 9601 LOWEN RD.
City or Community COMPTON, CALIF.
Driver JOHN PRESTON HOWARD
Res. Address 1313 ELM ST. City LONG BEACH, CAL.
MAILING ADDRESS 9605 LOWEN RD. CITY COMPTON

SEX	HEIGHT	DATE OF BIRTH	WEIGHT
M	6'-2"	DEC. 10, 1930	194 LBS.

COLOR OF EYES	COLOR OF HAIR	VEH. TYPE - COLOR
BLUE	BLOND	DIAMOND T (GREEN)

WEATHER	TYPE OF OPERATION	TRAFFIC
[✓ CLR] OVCST FOG RAIN	[✓ LEVEL] UP-HILL THR-GEAR	HVY [✓ MED] LT

YOU ARE CHARGED WITH A VIOLATION OF SECTION 24242 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA BY EMITTING # 4 BLACK SMOKE AGGREGATING 8 MINUTES IN ONE HOUR FROM 8:50 AM TO 9:02 AM WHILE TRAVELING ON ALAMEDA ST. FROM ALONDRA BL. (COMPTON) TO VERNON AV. (L.A.)

John Preston Howard Driver's Signature	Paul Brown Inspector	61 Badge No.
1313 Elm St. L.B. Address	A. Joe Jones Inspector	71 Badge No.

NOTE: PARTIES CONCERNED WILL BE NOTIFIED BY MAIL OF THE ACTION TAKEN ON THE ABOVE CHARGE.

76N635—10/59

Figure XIII - 5. Vehicle Notice.

Reading Visible Emissions, "Reading Smoke in the Field." But the procedures for reporting violations from automobiles used as private passenger vehicles, and commercial trucks, vary.

Passenger vehicles emitting excessive smoke are cited under Section 27153 of the Motor Vehicle Code of the State of California which states that "no motor vehicle shall be operated in a manner resulting in the escape of excessive smoke, flame, gas, oil, or fuel residue". The term "excessive" in this law is not defined, but it can be taken to mean any quantity of smoke which is outstanding enough to draw attention to the vehicle emitting it.

The inspector should be prepared to define what he thinks is "excessive" in each situation. Normally, as a matter of policy, the inspector will employ a 40% opacity standard without the time element. But if the smoke plume obscures the traffic area, is continuous through more than one gear, is outstanding, or is a nuisance, he can take action under Section 27153.

The citation used in Section 27153 cases is similar to those used by police officers for citing moving violations (see Figure XIII-4). The first copy serves as the court complaint, the second is reviewed and filed for record, the third is served to the defendant, and the fourth is retained in the citation book to refresh the inspector's memory should a court appearance be necessary.

The citation must be made out accurately the first time. Section 40505 of the Vehicle Code requires that all written information set forth upon the original (pink copy) shall also appear on the Violator's Copy.

Where errors due to inaccuracy and omission on the citation occur, a special *Citation Correction Request* is prepared. This is usually stapled to the citation.

Since violators are cited directly to court it is important that the inspector insert on the Citation the proper court jurisdiction. For the purpose of identifying the jurisdiction, the inspector consults a specially-prepared map.

For trucks and commercially-owned vehicles, the citation can be used, or the special V-type Written Notice (Figure XIII-5), but never both for the same vehicle. The V-type Vehicle Notice parallels the Notice of Violation used for stationary sources in that the Section 24242 standard is applied. The inspector must follow the vehicle until he obtains an emission which exceeds more than No. 2 Ringelmann for a period totaling more than three minutes in one hour. The variation in emissions exceeding the No. 2 Ringelmann standard, however, need not be itemized. The inspector uses the accumulative stop watch method by totaling the periods of time in which Ringelmann dens-

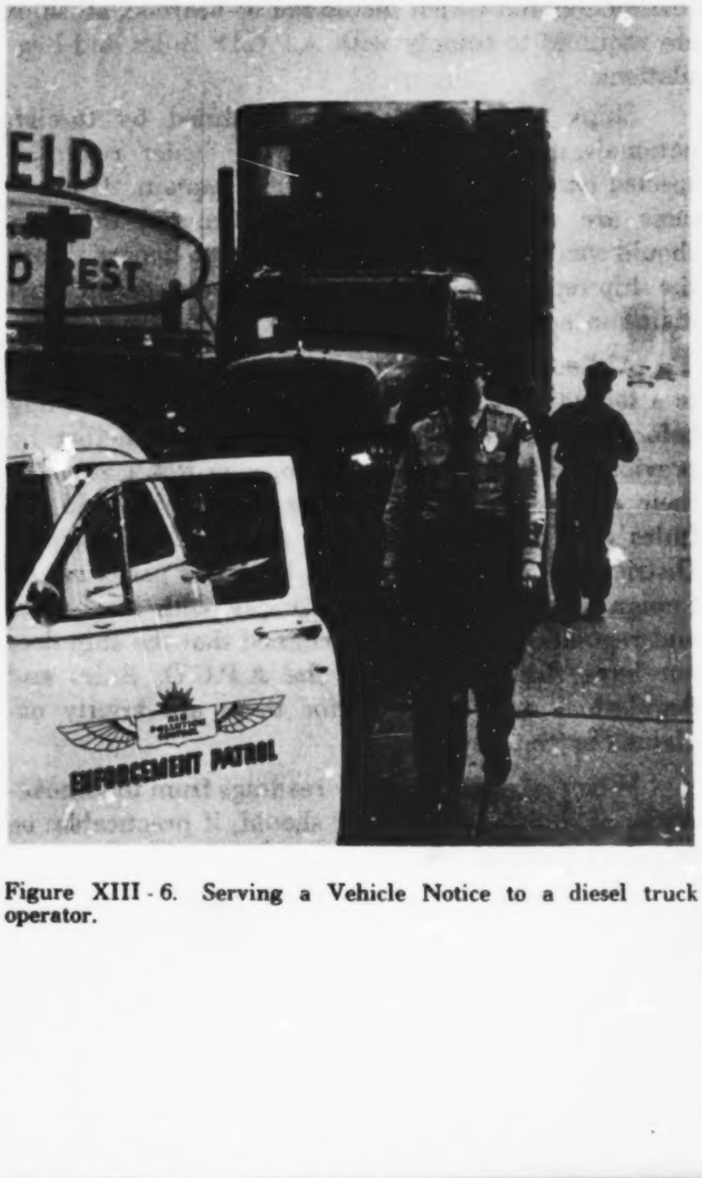


Figure XIII - 6. Serving a Vehicle Notice to a diesel truck operator.

ities of No. 2 or more are observed. To allow for margins of error, the violation observed should exceed No. 3 black smoke and total more than 4 minutes in any one hour.

The V-Notice differs from the C-Notice in that it does not cite the violator directly to court. Legal action is taken by preparing a *Request for Complaint* in the same manner as for stationary sources. The parties concerned are notified after filing of complaint. The V-Notice thus can be used for charging owners of the commercial vehicle with the violation and is particularly useful when a trucking firm operates vehicles in poor condition. The C-Notice, for commercial vehicles, is used only when the driver appears responsible for the violation as a result of poor operation of the equipment. The decision to use either of the two violation forms, therefore, must be based on the merits of each violation.

(2) Ships

The problems encountered in citing ships for violations differ greatly from those found in other areas of enforcement due to such factors as mobility, and the special laws, customs and mechanics involved in their operation. However, the inspector must be able to analyze the circumstances surrounding ship violations to determine whether or not a Written Notice is to be issued and to compile the evidence necessary to establish a sound legal case.

With the exception of U. S. Government ships and foreign men of war, over which the A.P.C.D. has no jurisdiction and which should not be boarded, all ships are required to comply with A.P.C.D. Rules and Regulations.

Ships of foreign registry, manned by foreign nationals, may be boarded and the boiler room inspected *only* with the consent of the captain. If objections are raised to the investigation, the inspector should conclude his business quickly and depart. Since the ship represents a foreign nation, the inspector must maintain a diplomatic attitude while on board.

Although the inspector may legally serve a notice to a foreign ship, it is well to establish by questioning before proceeding with the investigation whether by previous visits to the port, or through notification by their agents, the officers of the ship understand the Rules and Regulations of the Air Pollution Control District. With few exceptions, informed personnel on foreign ships are willing to comply with local rules and regulations. If it is determined that the ship does not have this information, the A.P.C.D. Rules and Regulations and the need for them are briefly explained by the inspector.

When recording opacity readings from the smokestacks of ships, the inspector should, if practicable, be in such a position that:

(1) The source is within 500 yards.

(2) The sun is perpendicular to the line of observation, if possible.

(3) The line of sight is at right angles to the direction of the plume.

Before boarding, the ship may be identified from the following:

(1) Name of ship painted on either side of bow.

(2) Registry (nationality) determined by flag at ship's stern.

(3) The name of the ship's home port customarily painted across the stern.

The inspector consults a card file maintained in his vehicle for previous record of violation and other information at hand, or contacts the regular ship's inspector or the office of the A.P.C.D., in the event that procedural questions should arise.

In boarding ships, the following contingencies should be noted:

(1) A ship should not be boarded which flies the yellow quarantine flag.

(2) Access to the ship is usually gained by means of the gangway normally located about halfway between the ship's bow and the stern.

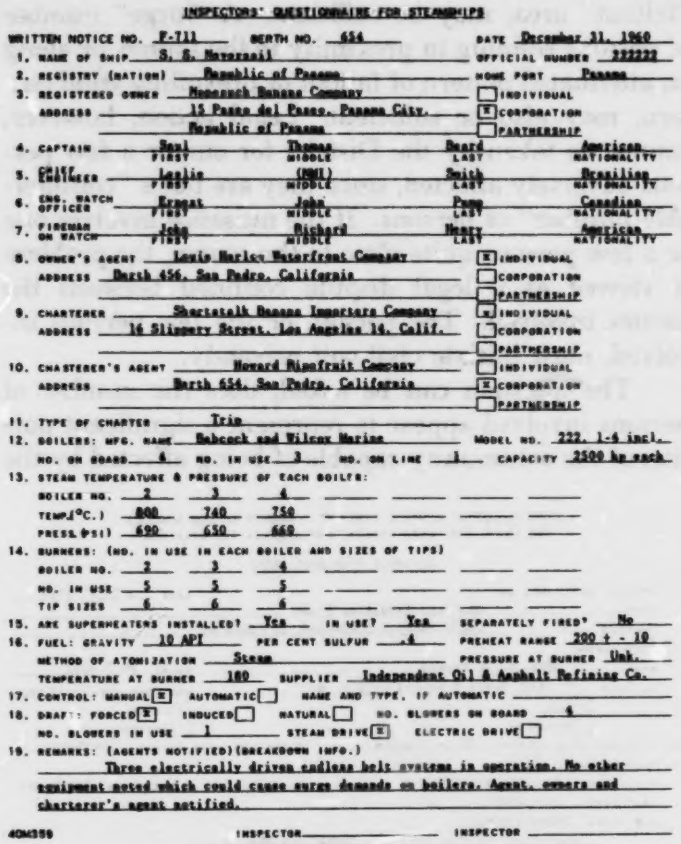
(3) U. S. ships requiring U. S. Coast Guard Security do not allow anyone on board without a U. S. Coast Guard Port Security Card.

(4) Once aboard, the inspector does not attempt to proceed through the ship unaccompanied. The inspector contacts the nearest ship's officer or crew member and asks to be directed to the Captain. All A.P.C.D. business should be conducted with the captain or, in his absence, with the *next* senior officer.

(5) The inspector then identifies himself and states the nature of his visit.

Since a ship may not remain long at the location at which the violation occurred, a full and correct identification of the ship, her owners and responsible persons must be obtained and recorded on page one of a special questionnaire form completed during the inspection of the ship, along with the written notice of violation (see Figure XIII-7).

In establishing identity and responsibility, the ship's document should be examined. It contains a complete description of the legal owner and the official number of the ship. The number, usually found in the upper right-hand corner, rather than the name (since several ships may bear the same name) serves to positively identify the ship. Documents for ships required to clear through U. S. Customs may be found at the U. S. Customs Office, Federal Building, San Pedro until sailing time. The inspector requests from the captain the information required to complete the questionnaire, and verifies the information so obtained by calling at the customs office for the purpose of citing the ship's document. However, if the document is



INSPECTORS' QUESTIONNAIRE FOR STEAMSHIPS

WRITTEN NOTICE NO. F-711 BERTH NO. 654 DATE December 31, 1960
1. NAME OF SHIP S. S. Nevernail OFFICIAL NUMBER 222222
2. REGISTRY (NATION) Republic of Panama HOME PORT Panama
3. REGISTERED OWNER Monarch Banana Company ☐ INDIVIDUAL
ADDRESS 15 Paseo del Paseo, Panama City. ☒ CORPORATION
Republic of Panama ☐ PARTNERSHIP
4. CAPTAIN Saul (FIRST) Thomas (MIDDLE) Beard (LAST) American (NATIONALITY)
5. CHIEF ENGINEER Leslie (FIRST) (NMI) (MIDDLE) Smith (LAST) Brazilian (NATIONALITY)
6. ENG. WATCH OFFICER Ernest (FIRST) John (MIDDLE) Pope (LAST) Canadian (NATIONALITY)
7. FIREMAN ON WATCH John (FIRST) Richard (MIDDLE) Henry (LAST) American (NATIONALITY)
8. OWNER'S AGENT Louis Harley Waterfront Company ☒ INDIVIDUAL
ADDRESS Berth 456, San Pedro, California ☐ CORPORATION
☐ PARTNERSHIP
9. CHARTERER Shortstalk Banana Importers Company ☒ INDIVIDUAL
ADDRESS 16 Slippery Street, Los Angeles 14, Calif. ☐ CORPORATION
☐ PARTNERSHIP
10. CHARTERER'S AGENT Howard Ripefruit Company ☐ INDIVIDUAL
ADDRESS Berth 654, San Pedro, California ☒ CORPORATION
☐ PARTNERSHIP
11. TYPE OF CHARTER Trip
12. BOILERS: MFG. NAME Babcock and Wilcox Marine MODEL NO. 222, 1-4 incl.
NO. ON BOARD 4 NO. IN USE 3 NO. ON LINE 1 CAPACITY 2500 hp each
13. STEAM TEMPERATURE & PRESSURE OF EACH BOILER:

BOILER NO.	2	3	4				
TEMP.(°C.)	800	740	750				
PRESS.(PSI)	690	650	660				

14. BURNERS: (NO. IN USE IN EACH BOILER AND SIZES OF TIPS)

BOILER NO.	2	3	4				
NO. IN USE	5	5	5				
TIP SIZES	6	6	6				

15. ARE SUPERHEATERS INSTALLED? Yes IN USE? Yes SEPARATELY FIRED? No
16. FUEL: GRAVITY 10 API PER CENT SULFUR .4 PREHEAT RANGE 200 + - 10
METHOD OF ATOMIZATION Steam PRESSURE AT BURNER Unk.
TEMPERATURE AT BURNER 180 SUPPLIER Independent Oil & Asphalt Refining Co.
17. CONTROL: MANUAL ☒ AUTOMATIC ☐ NAME AND TYPE, IF AUTOMATIC
18. DRAFT: FORCED ☒ INDUCED ☐ NATURAL ☐ NO. BLOWERS ON BOARD 4
NO. BLOWERS IN USE 1 STEAM DRIVE ☒ ELECTRIC DRIVE ☐
19. REMARKS: (AGENTS NOTIFIED)(BREAKDOWN INFO.)
Three electrically driven endless belt systems in operation. No other equipment noted which could cause surge demands on boilers. Agent, owners and charterer's agent notified.

40M358 INSPECTOR INSPECTOR

Figure XIII - 7. Inspector's Questionnaire for steamships. This form is used to obtain evidence relating to the ownership of the ship (home port, charter agent, etc.) and the operational data of the fireroom (boilers, burners, draft control methods, light-off methods and breakdown information) in establishing the facts of the violation.

aboard the ship it should be produced for inspection so that the information may be directly obtained.

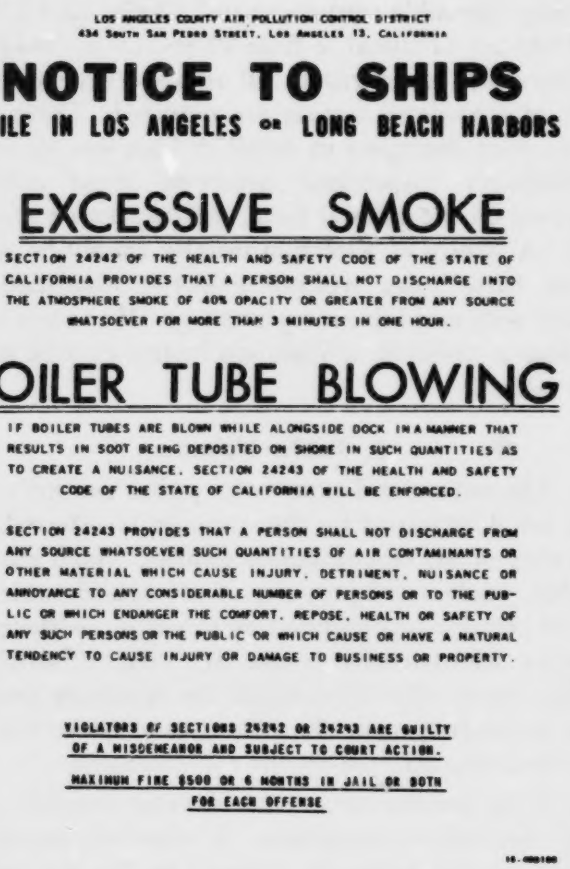
Certain conditions occur which normally exempt ships from violation. During periods when ships are maneuvering in confined waters, many sudden changes in the demand for steam from the boilers occur. At such times, the fireroom personnel are obliged to cut burners on and off as fast as possible. Special, large, maneuvering tips are used in the burners to insure maximum power, if required. It is usually impractical to maneuver the average merchant ship without making smoke, a fact which can be substantiated by expert testimony in court. Therefore, Section 24242 and Section 24243 are not applicable for ships while underway in the harbor or maneuvering to get underway or alongside. In this connection it should be mentioned that it usually takes not less than one-half hour for a newly arrived ship to change her boiler plant setup, i.e., put in smaller burner tips from maneuvering to "in port" during which period of time some smoke is unavoidable, although the usual precautions may have been observed.

Blowing tubes to eliminate soot is also considered necessary to avoid a serious fire hazard, and a citation for violation of Section 24242 should not be served. However, ships are required to blow tubes at such times when the wind will carry the resulting soot emissions away from such shore installations as parking lots, yacht harbors, cafes, warehouses, etc. If an inspector observes a ship blowing tubes in such a manner that a public nuisance is committed, he may serve a Notice for violation of Section 24243. If complainants are available and are willing to appear in court they should be given nuisance complaint forms for completion.

In all cases where a written notice is to be served and in cases where there is doubt in the mind of the inspector as to the actual cause of the violation, permission to inspect the fireroom of the ship to obtain information for completion of the questionnaire should be requested. When the investigation discloses that a smoke emission was the result of a mechanical breakdown or engineering casualty beyond control of operating personnel (such as burned-out blower motors, water in fuel oil, pump casualty, etc.) service of a written notice is inadvisable. Courts do not as a rule convict steamship companies when equipment breakdowns can be demonstrated. However, a complete inspector's report should be submitted.

If, after inspection, there is reasonable doubt in the inspector's mind that an engineering casualty occurred, he should serve the written notice to the captain or officer acting in his place. The completed questionnaire is then submitted to describe the circumstances of the violation and substantiate the notice.

After leaving the ship, the inspector proceeds to notify the office of the owner's agent and/or charterer of the fact that the ship has been issued a written no-



LOS ANGELES COUNTY AIR POLLUTION CONTROL DISTRICT
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

NOTICE TO SHIPS
WHILE IN LOS ANGELES OR LONG BEACH HARBORS

EXCESSIVE SMOKE

SECTION 24242 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA PROVIDES THAT A PERSON SHALL NOT DISCHARGE INTO THE ATMOSPHERE SMOKE OF 40% OPACITY OR GREATER FROM ANY SOURCE WHATSOEVER FOR MORE THAN 3 MINUTES IN ONE HOUR.

BOILER TUBE BLOWING

IF BOILER TUBES ARE BLOWN WHILE ALONGSIDE DOCK IN A MANNER THAT RESULTS IN SOOT BEING DEPOSITED ON SHORE IN SUCH QUANTITIES AS TO CREATE A NUISANCE, SECTION 24243 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA WILL BE ENFORCED.

SECTION 24243 PROVIDES THAT A PERSON SHALL NOT DISCHARGE FROM ANY SOURCE WHATSOEVER SUCH QUANTITIES OF AIR CONTAMINANTS OR OTHER MATERIAL WHICH CAUSE INJURY, DETRIMENT, NUISANCE OR ANNOYANCE TO ANY CONSIDERABLE NUMBER OF PERSONS OR TO THE PUBLIC OR WHICH ENDANGER THE COMFORT, REPOSE, HEALTH OR SAFETY OF ANY SUCH PERSONS OR THE PUBLIC OR WHICH CAUSE OR HAVE A NATURAL TENDENCY TO CAUSE INJURY OR DAMAGE TO BUSINESS OR PROPERTY.

VIOLATORS OF SECTIONS 24242 OR 24243 ARE GUILTY OF A MISDEMEANOR AND SUBJECT TO COURT ACTION.

MAXIMUM FINE $500 OR 6 MONTHS IN JAIL OR BOTH FOR EACH OFFENSE

Figure XIII - 8. Informational poster for ships.

tice. The agent is given any of the pertinent facts surrounding the violation which appears on the *face* of the written notice. This notification is considered necessary so that the agent has time to prepare a written statement from the captain and/or notify the insurance underwriters before the ship sails. The fact that the agent has been notified is included in the inspector's report.

(3) Railroad Trains

Special data pertinent to responsibility and cause are also required for locomotives which smoke excessively. Since locomotives cannot be halted, the inspector reports his findings on the general report form, *The Inspector's Field Report*. The following data are included:

1. The street on which the train was observed and followed and the intersections and cities where the observation began and ended.
2. Periods of excessive smoke either by interval or accumulated stopwatch method.
3. Name of railroad and locomotive number.
4. Direction traveling.
5. Whether the train was going upgrade, downgrade or level, whether it was stopped or moving. Give approximate speed and number of cars.
6. Was engine being sanded?

2. "Invisible Contaminants"

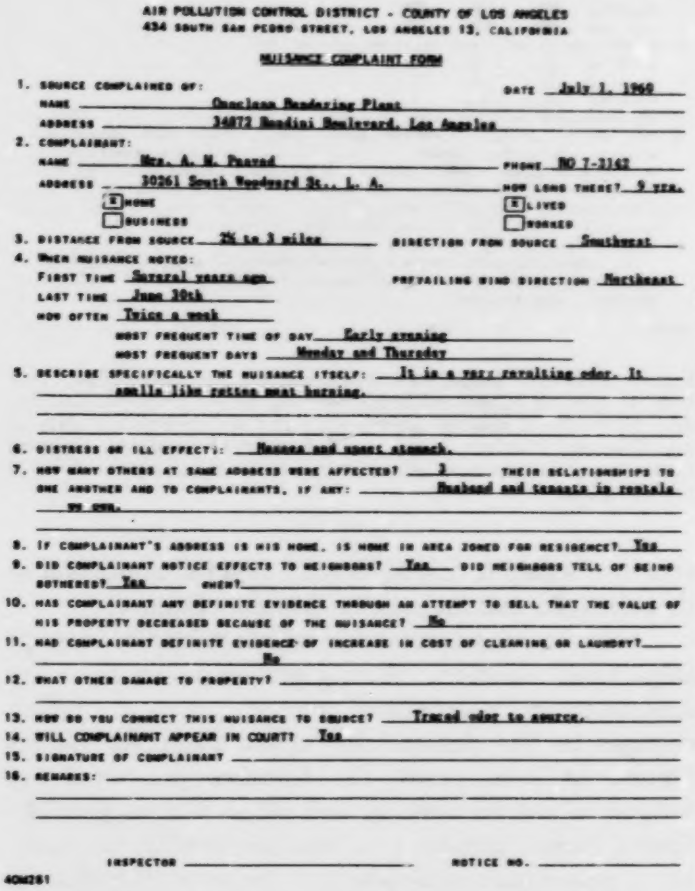
The elements required to establish violations involving "invisible contaminants" (Rules 52, 53, 54, 62 and 64) are identical to Rule 50 and other "maximum permissible" standards in all respects except that results of laboratory testing are required. These procedures were described in detail in Chapters 10 and 11. Preliminary inspections involving these rules are reported on the general form, the *Inspector's Field Report*. A Notice of Violation usually cannot be written under these rules without evidence furnished from source tests and laboratory analysis. If the test results disclose a violation, a Violation Notice may be written and issued.

3. Public Nuisance

The nature and extent of a public nuisance violation are determined by the community affected. Any quantity of air contaminants emitted which affect the health, comfort and property of any considerable number of persons is prohibited by this rule. Although the District initiates legal action in public nuisances and makes every effort to compile the necessary evidence, it is incumbent upon the witnesses to prove that they are adversely affected by the contaminants.

What constitutes a "considerable number of persons" depends on conditions. A relatively small number of persons adversely affected by the air contaminants and confined to a definitely limited "effect" or "fallout" area, may be sufficient. A "large" number of persons residing in proximity to the source, or along an attenuated pattern of fallout or prevailing wind pattern, may also be sufficient. Legal action, however, cannot be taken by the District for one or a few persons adversely affected, since they are not a "considerable number" of persons. If the nuisance involves one or a few persons quite close to the source, the problem is viewed as a legal dispute confined between the parties involved. The person, or the few persons involved, must initiate civil suit privately.

The question can be asked, does the number of persons involved appear to represent a significant portion of the community capable of being affected by the nuisance? Does the inspector himself feel that an undesirable or obnoxious nuisance exists? If he does, the inspector himself is automatically one of the witnesses. Also those persons who complain, or express a strong attitude of annoyance towards the nuisance do not materially count in establishing the nuisance if they are incapable or unwilling to give testimonial evidence in court.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

NUISANCE COMPLAINT FORM

1. SOURCE COMPLAINED OF: DATE July 1, 1960
NAME Oneclean Rendering Plant
ADDRESS 34872 Bandini Boulevard, Los Angeles
2. COMPLAINANT:
NAME Mrs. A. M. Pnavad PHONE NO 7-3142
ADDRESS 30261 South Woodward St., L. A. HOW LONG THERE? 9 yrs.
☒ HOME ☒ LIVED
☐ BUSINESS ☐ WORKED
3. DISTANCE FROM SOURCE 2½ to 3 miles DIRECTION FROM SOURCE Southwest
4. WHEN NUISANCE NOTED:
FIRST TIME Several years ago PREVAILING WIND DIRECTION Northeast
LAST TIME June 30th
HOW OFTEN Twice a week
MOST FREQUENT TIME OF DAY Early evening
MOST FREQUENT DAYS Monday and Thursday
5. DESCRIBE SPECIFICALLY THE NUISANCE ITSELF: It is a very revolting odor. It smells like rotten meat burning.
6. DISTRESS OR ILL EFFECTS: Nausea and upset stomach.
7. HOW MANY OTHERS AT SAME ADDRESS WERE AFFECTED? 3 THEIR RELATIONSHIPS TO ONE ANOTHER AND TO COMPLAINANTS, IF ANY: Husband and tenants in rentals we own.
8. IF COMPLAINANT'S ADDRESS IS HIS HOME, IS HOME IN AREA ZONED FOR RESIDENCE? Yes
9. DID COMPLAINANT NOTICE EFFECTS TO NEIGHBORS? Yes DID NEIGHBORS TELL OF BEING BOTHERED? Yes WHEN?
10. HAS COMPLAINANT ANY DEFINITE EVIDENCE THROUGH AN ATTEMPT TO SELL THAT THE VALUE OF HIS PROPERTY DECREASED BECAUSE OF THE NUISANCE? No
11. HAD COMPLAINANT DEFINITE EVIDENCE OF INCREASE IN COST OF CLEANING OR LAUNDRY? No
12. WHAT OTHER DAMAGE TO PROPERTY?
13. HOW DO YOU CONNECT THIS NUISANCE TO SOURCE? Traced odor to source.
14. WILL COMPLAINANT APPEAR IN COURT? Yes
15. SIGNATURE OF COMPLAINANT
16. REMARKS:

INSPECTOR NOTICE NO.
40M281

Figure XIII - 9. Nuisance complaint form prepared by complainants for information and use of the District or City Attorney.

In any public nuisance action, therefore, the inspector interviews potential witnesses. It is not his purpose to urge, force or persuade witnesses into court. The inspector is limited to determining (1) whether the complaint is justified, (2) whether or not the complainant will testify. If the complainant is willing to testify in court, the inspector gives the complainant a District Attorney form (see Figure XIII-9) to complete in his or her own handwriting. When a sufficient number of these forms are collected—at least enough to represent the community—a Section 24243 Public Nuisance Notice is written and served to the responsible parties at the source. The Inspector's Notice must show the manner in which he has tracked and identified the contaminants as discussed in Chapter Twelve. The operating conditions, the cause of the emissions of the undesirable air contaminants should be noted as in any other violation involving the emission of excessive air contaminants.

B. *Unauthorized Construction or Operation of Equipment*

The authority behind the operation and enforcement of the permit system consists of the following: (See also pages 252-254, Chapter 14.)

Rule 10—requires authority to construct and permit to operate and posting of operating permits.

Rule 11 and Section 24265—exempt many pieces of inconsequential equipment.

Rule 12—permits are nontransferable.

Rule 13—blanket permits for equipment operated between December 1, 1947 and February 1, 1948.

Rule 14—requires submission of applications for permit and authority to construct.

Rule 18—governs action on applications.

Rule 19—requires provision for sampling facilities.

Rule 20—standards for granting permits.

Rule 21—conditional approval.

Rule 22—denial of application.

Rule 23—further information which may be required.

Rule 24—applications deemed denied.

Rule 25—appeals.

Regulation III deals entirely with the subject of permit fees.

Section 24278—unauthorized operation under a suspended or revoked permit.

Section 24279—unauthorized construction and operation of equipment.

Section 24280—operating contrary to provision of permit.

1. Section 24279

In Los Angeles County the inspector is not directly concerned with the processing of permit applications or engineering analysis — this is the function of the Engineering Division — but rather with the enforcement of Sections 24278, 24279 and 24280 of the State Health and Safety Code which deal with unauthorized construction and operation of equipment. When the inspector finds such equipment, he serves either a *Notice of Violation* and a *Request for A.P.C.D. Permit* (see Figure XIV-17) or the *Request* alone, depending on the "extent" of the violation. The *Notice* leads to direct court action whereas the *Request* allows the owner or operator to apply for his permit within 10 calendar days.

a. Determining Permit Status

In determining unauthorized construction and operation (Section 24279), the following standards and tests are applied in determining the "permit status" of each piece of equipment, i.e., the exact status of compliance with respect to those rules and regulations which govern the operation and procedures to be followed in the permit system. If all three of the following conditions obtain, then the equipment comes within the jurisdiction of the permit system.

1. The equipment is capable of emitting air contaminants as defined by Section 24208. (See Chapter 9, *Identifying Effluent Plumes.*)
2. The equipment was constructed, altered, replaced, or was involved in a change of ownership or change of address location anytime subsequent to the effective dates when permits were required by the Rules and Regulations. (See page 252, Chapter 14.)
3. The equipment is not legally exempted by Rule 11 or Section 24265, or it is not administratively or temporarily exempted.

The second step in determining permit status concerns an accurate determination of 2 above — the exact reason a permit is required. This is accomplished by determining the status of construction, the status of ownership, the status of location, and the structural status of equipment. Should there be a change in any of these statuses and Conditions 1 and 2 above apply, then the status of the equipment with reference to the permit system is one of noncompliance.

(1) Determining Status of Construction

(a) If the construction or installation of the equipment was completed more than six months previously, and no change of ownership was involved since the construction date, then the status of the equipment is administratively considered as "new construction." Equipment with this status requires a permit to operate and the inspector issues a REQUEST TO APPLY FOR A.P.C.D. PERMIT.

(b) If the equipment was constructed or installed within an approximate previous six-month period, or is now being installed, it is administratively considered as involving "recent" or "current construction", and will require a permit. (An F-NOTICE usually is issued.)

(c) If new equipment is partially constructed on the premises of the company, but is not being constructed during the inspector's observation, and if the responsible person claims that the equipment is not being constructed or used, and that the company does not intend using the equipment in the immediate future, a permit is not required. The person should be informed that any further construction is illegal unless he applies for and receives an "Authority to Construct" from the A.P.C.D.

(d) If new equipment is on the premises and the person claims that no additional construction is underway, but the inspector on subsequent visits observes construction of equipment taking place, or observes progressive completion of construction, then an "Authority to Construct" is necessary and the inspector serves an F-Type Notice.

(2) Determining Status of Ownership

The number of different situations in which ownerships can change among partnerships, individual owners and corporations are numerous. These are listed in Table XIII-1.

TABLE XIII-1
CHANGE OF OWNERSHIP SITUATIONS

PARTNERSHIP AND INDIVIDUAL OWNERS	CHANGE	NO CHANGE
1. Any change from individual ownership to partnership or from partnership to individual owner	X	
2. Individual ownership or partnership purchases equipment from another individual, partnership, or corporation	X	
3. Individual owner or partnership incorporates	X	
4. Individual owner or partnership changes name of business only.		X
5. A partnership with more than two partners is operating a business and the partnership loses one or more of the partners, and a partnership still exists.		X
6. Partnership of two or more partners obtains an additional partner or partners.		X
7. Partnership of two persons is dissolved by one partner dying, or otherwise leaving, and business continues operation as an individual ownership.	X	
8. Man and wife operate a partnership and:		
a. One dies.	X	
b. They are divorced and one takes over operation as an individual owner	X	
9. Individual owner or partnership sells all assets of business and it then changes from a subsidiary company to a corporation without change in name of subsidiary.	X	
10. A trustee is operating a business and another trustee, for any reason, is appointed in his place.		X
CORPORATIONS		
1. Corporation sells equipment to another corporation, individual or partnership.	X	
2. "A" Corporation builds a new plant and obtains permits. Plant is then leased to another organization.	X	
3. Lessee in situation #2 above gives up lease and Corporation "A" operates the same equipment.		X
4. Corporation changes name, but not corporate structure.		X
5. Individual sells 100% of stock in Corporation "A" to another corporation. Corporation "A" continues to operate with no change in structure. (Note that this is only a sale of stock, and not equipment.)		X
6. One corporation forms another corporation and equipment from old (but still existing) corporation is sold to the new corporation.	X	
7. The corporation selling the equipment in #6 above repurchases the equipment originally sold and resumes operation of that equipment.		X
8. A corporation merges with another corporation.		X
NOTE: Only corporations can merge. On the merger, the corporation can take either name and may continue to operate equipment without a new permit. A change in name permit can be issued without a fee. In determining corporation compliance with permit requirements, official merger records should be checked.		

(3) Determining Change in Location

(a) A change of location made by moving equipment on the same premises will not require a permit as long as no structural changes are involved.

(b) The movement of equipment from one address-location to another requires permits.

(4) Determining Alteration

Alteration may be considered as any structural change which changes the quality, nature or quantity of air contaminant emissions such as: alteration of combustion chamber, vents, ports, stack, charging doors, etc.; substitution of burners, change in type of fuels used; alteration of load capacities, reduction or increase of blower capacities; substitution of chemicals, etc.

When the permit status is one of non-compliance for any of the above reasons, then a violation of Section 24279 is indicated. The enforcement action to be taken then depends on the inspector's findings as to the "extent" of the violation, that is, was the equipment constructed with the knowledge of the A.P.C.D. law? Are there extenuating circumstances involved? The District policy in this regard considers recency of construction as a standard of "extent", since plant operators are expected to have full knowledge of the requirements of the control program as the control program becomes better known. On the other hand, a more lenient enforcement policy is applied when failure to apply is clearly a result of ignorance or confusion. Determination of flagrancy is simply a matter of assessing all of the factors involved. The District has the option to take any form of enforcement action which is reasonably necessary, once a violation of Section 24279 is confirmed. The action taken will consist of one of the following:

Issuance of the F-Type Permit Notice:

Generally speaking, this Notice is issued only when the violation is flagrant, due to recency, intent and past history of violation, or other contributing factors. It is also issued for operation after issuance of denial, failure to submit applications within the "due-date", and in conjunction with notices issued for any other violation of the Rules and Regulations incurred at the same time.

The written Notice should establish when construction began and was completed, the actual cause of the noncompliance as outlined above, the name, home and business address of the contractors involved, etc. and all pertinent data which establishes responsibility as described under "Establishing Persons Responsible for the Violation", this chapter. The findings of the Notice will also note the exact stage of completion of the equipment and observations of any visible emissions noted.

Should equipment, for which an application for operating permit has been denied, be observed in operation, the inspector should note the time and date of operation and the degree to which the equipment is being operated as well as any visible emissions observed.

The Request for A.P.C.D. Permit is also written and issued together with an appropriate set of applications.

This form, together with appropriate permit application forms, is usually issued without the F-Notice when stringent action is not being taken. It is generally issued for equipment involved in a change of ownership and change of location.

Issuing the Request to Apply for APCD Permit Only.

The *Request* is made out in triplicate. The first copy is the plant manager's copy, the second is a report of the permit status for engineering review and the third is maintained in a suspense file until the applications are submitted to the Engineering Division.

The *Request* form is for the most part a blank completion type form containing the special elements of Section 24279 violation.

2. Section 24280, Operation or Erection Contrary to Provision of Permit

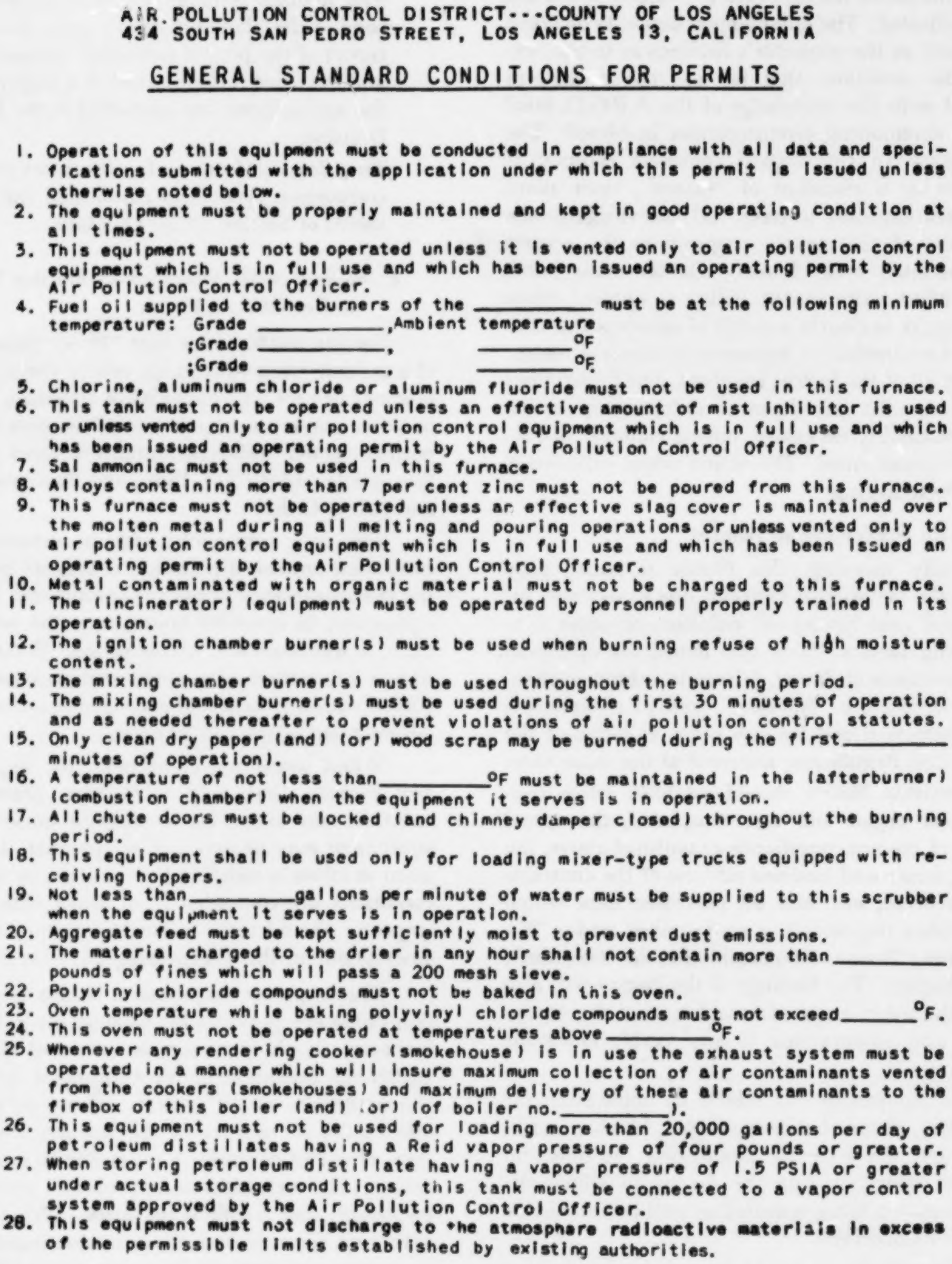
Section 24280 states that "Every person is guilty of a misdemeanor who builds, erects, alters, or replaces, operates or uses any such article, machine, equipment, or other contrivance contrary to the provision of any permits issued under regulations adopted pursuant to this article." (Article 4, Rules and Regulations, Health and Safety Code.)

This is a very useful rule in enforcement since continued control of pollution is assured by conditioning the operation of permitted equipment. Should such equipment be operated contrary to the permit conditions, a misdemeanor is committed. When the violation is committed in a public nuisance case or is involved with a violation of excessive emissions, effective enforcement action can be taken.

When inspecting equipment, the inspector reads any permits that may have been granted by the A.P.C.D. and notes the conditions under which the equipment may or may not be operated. If the equipment involves a complex flow process, or its operating conditions are concealed from direct observation, the inspector should refer to flow diagrams of equipment descriptions in the Engineering Division File.

The inspector may issue a Notice under this section of the law provided his findings are definitive. The inspector should demonstrate in detail the extent to which the operation of the equipment deviated from the conditions on the permit. Where no violations of other rules or sections of the law are involved, issuance of a Notice under Section 24280 may be discretionary. In such cases an appropriate warning should be issued, and a follow-up made. Where violations involving the emission of air contaminants, or public nuisances are involved in connection with failure to comply with the permit conditions, the appropriate notice should be written and served, together with the Section 24280 F-Type Notice.

A list of typical permit conditions is shown in Figure XIII-10.



AIR POLLUTION CONTROL DISTRICT---COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

GENERAL STANDARD CONDITIONS FOR PERMITS

1. Operation of this equipment must be conducted in compliance with all data and specifications submitted with the application under which this permit is issued unless otherwise noted below.
2. The equipment must be properly maintained and kept in good operating condition at all times.
3. This equipment must not be operated unless it is vented only to air pollution control equipment which is in full use and which has been issued an operating permit by the Air Pollution Control Officer.
4. Fuel oil supplied to the burners of the __________ must be at the following minimum temperature: Grade __________, Ambient temperature
   ;Grade __________, __________°F
   ;Grade __________, __________°F
5. Chlorine, aluminum chloride or aluminum fluoride must not be used in this furnace.
6. This tank must not be operated unless an effective amount of mist inhibitor is used or unless vented only to air pollution control equipment which is in full use and which has been issued an operating permit by the Air Pollution Control Officer.
7. Sal ammoniac must not be used in this furnace.
8. Alloys containing more than 7 per cent zinc must not be poured from this furnace.
9. This furnace must not be operated unless an effective slag cover is maintained over the molten metal during all melting and pouring operations or unless vented only to air pollution control equipment which is in full use and which has been issued an operating permit by the Air Pollution Control Officer.
10. Metal contaminated with organic material must not be charged to this furnace.
11. The (incinerator) (equipment) must be operated by personnel properly trained in its operation.
12. The ignition chamber burner(s) must be used when burning refuse of high moisture content.
13. The mixing chamber burner(s) must be used throughout the burning period.
14. The mixing chamber burner(s) must be used during the first 30 minutes of operation and as needed thereafter to prevent violations of air pollution control statutes.
15. Only clean dry paper (and) (or) wood scrap may be burned (during the first __________ minutes of operation).
16. A temperature of not less than __________°F must be maintained in the (afterburner) (combustion chamber) when the equipment it serves is in operation.
17. All chute doors must be locked (and chimney damper closed) throughout the burning period.
18. This equipment shall be used only for loading mixer-type trucks equipped with receiving hoppers.
19. Not less than __________ gallons per minute of water must be supplied to this scrubber when the equipment it serves is in operation.
20. Aggregate feed must be kept sufficiently moist to prevent dust emissions.
21. The material charged to the drier in any hour shall not contain more than __________ pounds of fines which will pass a 200 mesh sieve.
22. Polyvinyl chloride compounds must not be baked in this oven.
23. Oven temperature while baking polyvinyl chloride compounds must not exceed __________°F.
24. This oven must not be operated at temperatures above __________°F.
25. Whenever any rendering cooker (smokehouse) is in use the exhaust system must be operated in a manner which will insure maximum collection of air contaminants vented from the cookers (smokehouses) and maximum delivery of these air contaminants to the firebox of this boiler (and) (or) (of boiler no. __________).
26. This equipment must not be used for loading more than 20,000 gallons per day of petroleum distillates having a Reid vapor pressure of four pounds or greater.
27. When storing petroleum distillate having a vapor pressure of 1.5 PSIA or greater under actual storage conditions, this tank must be connected to a vapor control system approved by the Air Pollution Control Officer.
28. This equipment must not discharge to the atmosphere radioactive materials in excess of the permissible limits established by existing authorities.

Figure XIII - 10. General standard conditions for permits.

3. Section 24278, Operation or Erection Under Suspended or Revoked Permit

According to Section 24278, every person who builds, erects, alters, replaces, uses or operates any source capable of emitting air contaminants when his permit has been either suspended or revoked is guilty of a misdemeanor.

The Air Pollution Control Officer can suspend a permit for a period of time, but only the Hearing Board can revoke a permit.

On suspension, the sector inspector is issued a written notification of such action, including the date involved.

On revocation, the sector inspector is issued a written report of the Hearing Board's action and another written reminder of the effective date of revocation.

The inspector in these cases inspects to determine whether or not the equipment is being operated. If he observes the equipment in operation he issues a Section 24278-F-Type Notice setting forth both the facts as to revocation or suspension and the time, date and description of the operation he has observed.

C. *Uncontrolled Equipment*

This violation category includes Rule 56, Uncontrolled Storage of Petroleum Products; Rule 59, Uncontrolled Oil-Effluent Water Separators; Rule 61, Uncontrolled Gasoline Loading into Trucks, Tanks and Trailers; Rule 62, Fuel Oil Burning; Rule 63, Gasoline Composition, and Rule 64, Reduction of Animal Matter. The evidence required for these violations was discussed previously in Chapters 11 and 12.

D. *Bans: Rule 57, Open Fires; Rule 58, Single-Chamber Incinerators*

A complete description of these Rules is contained in the Rules and Regulations, which should be consulted for detailed conditions and exceptions.

1. Rule 57, Open Fires

Because the elements of an open fire, Rule 57, violation are involved, the entire rule is quoted as follows:

> Rule 57*. (Amended 1-16-58.) OPEN FIRES. A person shall not burn any *combustible refuse* in any open outdoor fire *within the Los Angeles Basin, except*:
>
> a. When such fire is set or permission for such fire is given in the performance of the official duty of any public officer, and such fire in the opinion of such officer is necessary:
>   1. For the purpose of the prevention of a fire hazard which cannot be abated by any other means, or
>   2. The instruction of public employees in the methods of fighting fire.
>
> b. When such fire is set pursuant to permit on property used for industrial purposes for the purpose of instruction of employees in methods of fighting fire.
>
> c. When such fire is set in the course of any agricultural operation in the growing of crops, or raising of fowls or animals.
>
> These exceptions shall not be effective on any calendar day on which the Air Pollution Control Officer determines that:
>
> 1. The inversion base at 4:00 a.m., Pacific Standard Time, will be lower than one thousand five hundred feet above mean sea level, and
> 2. The maximum mixing height will not be above three thousand five hundred feet, and
> 3. The average surface wind speed between 6:00 a.m. and 12:00 noon, Pacific Standard Time, will not exceed five miles per hour.

The investigating inspector proceeds to investigate violations according to standing instructions as extracted from the following joint agreements between fire departments and the Air Pollution Control District.

a. Contact person who is burning the refuse to determine if he has a permit issued by a Fire Department.

b. If burning is performed under oral or written permit, but in violation of the terms and conditions of the permit, the person performing such burning may be cited by the inspector.

c. If burning is performed according to oral or written permit, but, in your opinion, conditions under which burning is performed are not satisfactory, the inspector shall contact the Fire Department from which the permit was issued. If, after consultation with Fire Department personnel, the open burning is found contributing to the smog condition, the Fire Department personnel will order the fire extinguished and cancel the permit. Decision as to whether permittee shall be served a notice will be made in conjunction with and upon the advice of Fire Department personnel.

d. If no oral or written permit was given to person performing the burning, a Notice should be issued.

e. If permit does not conform to details of joint agreement mentioned above, contact Fire Department issuing permit and attempt to obtain their cooperation on these points.

f. The A.P.C.D. issues no fire permits. The fire departments in Los Angeles County and some local communities will issue permits subject to the following:
   1. No permits will be issued on days when a Smog Warning is forecast.
   2. The words "This permit not valid on a smog forecast day" should be checked on the permit.
   3. Permits for weed abatement will be issued where weed removal cannot be feasibly disposed of by some other method. The permittee will be informed that the permit is *only* for the burning of grass and weeds and *not* for any other combustible material.
   4. Before issuing a permit to eliminate a fire hazard every effort will be made, where practicable to have the person find an alternate method of disposal. Sound consideration should be given to all factors involved so that the most reasonable degree of cooperation can be given the Fire Departments.
   5. Permits in connection with training in the methods of fire control may be issued when no smog is forecast.
   6. Permits for bonfires for amusement purposes may be issued under specified conditions. For example: Halloween bonfires at playgrounds, homecoming bonfires, etc.

When writing a Notice of Violation, the following points should be kept in mind:

1. When the observation of the emission from an open fire does not disclose a violation of Section 24242, but visible emissions are observed, the inspector should record the actual emission observed in the visible emissions box on the Notice, but should not total the emissions. The box should then be crossed out lightly.

2. In collecting data for open fires, it is important that the persons responsible for, and lighting, the fire be definitely established. In addition, the contents of the fire should be accurately described.

   The following check points apply.

   a. Size—diameter and height.

   b. Location—distance from any near structure.

---

* Emphasis supplied.

c. Materials being burned — describe whether green, wet, etc.

d. Permit from local Fire Department.
   Has date expired?
   Does permit have a stamped or written condition concerning burning of "heavies" or A.P.C.D. Regulations?
   Does permit have clause making it invalid on smoggy days?
   Are terms of permit adhered to?
   Who issued the permit?

e. Are means available to extinguish fire?

f. Is there someone in attendance at the fire?

g. Did you see anyone throw anything onto the fire or stir, rake or control the fire in any manner?

h. Was attempt being made to put fire out: Upon arrival? Not at all?

i. Are there any signs or other information in the area that would indicate who is doing the burning?

j. Was the fire in view at the time of the observation?

k. Was any attempt made to segregate the heavies?

2. Rule 58, Single-Chamber Incinerators

Rule 58, in effect, makes it illegal to burn combustible rubbish within the Los Angeles Basin in any incinerator other than an approved multiple-chamber incinerator.

The necessary elements of this violation which must be established are: (1) the burning of *combustible rubbish* (i.e., not fuels), (2) in a single-chamber incinerator or any other incinerator which does not have an operating permit from the Air Pollution Control District and (3) within the Los Angeles Basin, the boundaries of which are defined in Rule 2g.

Under the "Findings" section of the Notice, the exact type of incinerator should be described by using the following terms, whichever is appropriate: "single-chamber", "multiple - chamber", "brick", "steel", "concrete", "hopper-type", "box-type", "chute-type", "cylinder", "conical", "tapered", etc. The inside dimensions of the combustion chamber should be included.

The materials burned and approximate quantities should be accurately described.

The persons responsible for charging and lighting the incinerator should be indicated and identified as well as all facts which establish responsibility.

E. *Noncooperation and Circumvention*

1. Refusal of Entry; Refusal to Halt Vehicle.

Section 24246 of the California Health and Safety Code, Chapter 2, Division 20, sets forth the powers of the control officer as follows:

> The Air Pollution Control Officer, during reasonable hours, for the purpose of enforcing or administering this chapter or of any order, regulation or rule prescribed pursuant thereto, may enter every building, premises, or other place, except a building designed for and used exclusively as a private residence and may stop, detain, and inspect any vehicle, designed for and used on a public highway but which does not run on rails. Every person is guilty of a misdemeanor who in any way denies, obstructs, or hampers such entrance, or such stopping, detaining, or inspection of such vehicle, or who refuses to stop such a vehicle upon the lawful order of the air pollution control officer.

For the practical purpose of enforcing this section in the field "refusal of entry" may mean not only refusal to permit entrance into any building or premises described above, but also refusal or failure to stop vehicles upon lawful order.

Several restrictions are imposed upon the Air Pollution Control Officer, however. First, an inspector may not enter a building "designed for and used exclusively as a private residence". If, however, a building designed as a private residence were used as a machine shop, the exemptions would not apply and an inspector would be empowered to enter for inspection purposes.

Secondly, the inspector must enter the building during "reasonable hours". The interpretation of "reasonable hours" would be in most instances confined to that time when the business or enterprise was open for business or was in operation. Under no circumstances may inspectors of the Air Pollution Control District enter any building, premises or other place at such times as the business would be considered closed or its activity suspended. At no time may an inspector use any force on any part of the premises to effect entrance.

The power of the Air Pollution Control Officer to stop, detain and inspect vehicles contains an exception with respect to those vehicles which run on rails. At no time may an inspector stop such a vehicle running on rails for the purposes contained in Section 24246. In addition to the exception set forth in this section, it is the policy of the Air Pollution Control District not to stop passenger-carrying buses for the purpose of enforcing the provisions of the Health and Safety Code, Rules and Regulations of the Air Pollution Control District or Vehicle Code.

If an inspector is refused entrance to any building, premises or other place after properly and lawfully identifying himself, he first requests permission to speak to top management or to the responsible person in charge at the time. If he succeeds in contacting top management, he courteously explains the reasons for the inspection of the premises and attempts to secure cooperation. If he is still unable to gain entrance, he attempts to obtain the identification of the person who has denied permission to enter or who has obstructed or hampered such entrance. The inspector then calls his head inspector and requests advice and instructions on procedure.

The head inspector or his representative then attempts to contact top management to effect the inspector's entrance. If entrance is still refused, the

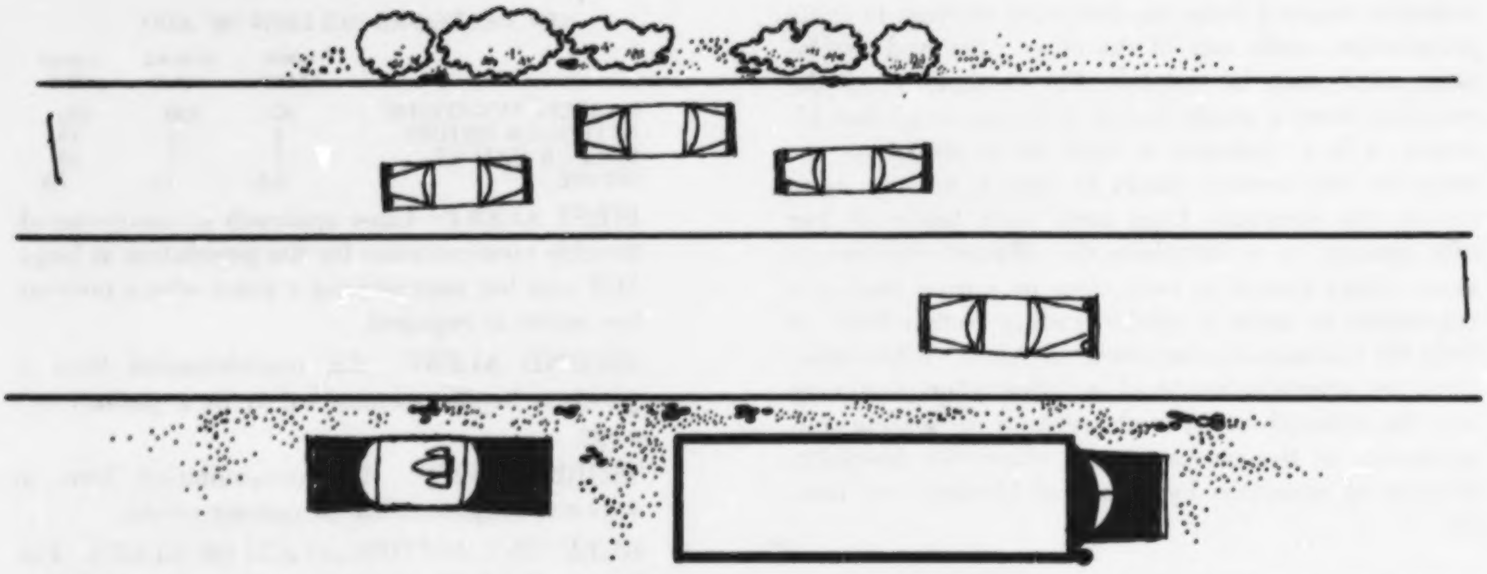


Figure XIII - 11. Halting of diesel cab and trailer on the highway. The patrol vehicle pulls behind the truck, clear of the highway.

head inspector consults the chief inspector. When they have determined the course of action, the inspector in the field is advised and instructed. It should be noted that at all times there is no urgency which would ever require immediate action by the inspector.

If it is determined that a Notice of Violation should be issued, this may be accomplished immediately by the inspector in the field, or at a later date, depending upon the need for further investigation. In no event is it considered necessary for the inspector in the field to attempt to effect a physical arrest.

Substantially, the same conditions exist with reference to stopping and inspecting motor vehicles. Every effort is made by the inspector to effect the lawful halting of the violating motor vehicle with complete regard to the rules of the road as defined in the Vehicle Code, and to the safety and protection of other motorists using the highway. In all cases the halting of a motor vehicle is accomplished by a uniformed inspector in a black-and-white patrol car, equipped with red lights and siren. (See page 127, Chapter 7.)

If the driver of the vehicle which the inspector wishes to halt refuses to follow or ignores the instructions of the inspector, the inspector secures the vehicle license number, cab number or other identification of the vehicle and observes the driver for the purpose of later identification in court if necessary. A full written report of the occurrence is then made by the inspector to his head inspector. If it appears that such information is sufficient to warrant the issuance of a complaint, the application for complaint is made by an investigator of the Enforcement Division.

a. Administrative Restrictions:

Certain administrative restrictions to entry of any premises are made in the following cases:

1. Only inspectors assigned to or accompanied by members of the Refinery and Chemical Section shall enter a refinery, tank farm, bulk loading station, gas or gasoline plant, petrochemical, chemical, paint or other plant for which that Section is responsible.
2. Only inspectors in possession of a U. S. Coast Guard port security card may board ships handling government material.
3. Only inspectors who have security clearance may enter plants requiring security checks.
4. Only inspectors driving emergency vehicles in the Patrol Section shall stop vehicles.

2. Rule 60, Circumvention

Rule 60, relating to reducing or concealing emissions, states that "A person shall not build, erect, install, or use any article, machine, equipment or other contrivance, the use of which, without resulting in a reduction in the total release of air contaminants to the atmosphere, reduces or conceals an emission which would otherwise constitute a violation" of the Rules and Regulations or the State Health and Safety Code. This rule does not apply to those cases in which the only violation involved is a public nuisance (Section 24243 or Rule 51).

In establishing a violation of this Rule it is necessary that the investigating inspector acquire detailed information of the operation in question both before and after the alteration of the device. The inspector must demonstrate from data of operating conditions that the total quantities of emissions both before and after the alteration remain the same, and that the violation resulted from the deliberate attempt to avoid prosecution under any of the other rules and regulations which may be violated. For example, when the emission from a single source is in excess of that allowed, it is a violation of Rule 60 to distribute the emission over several stacks in such a manner as to reduce the emissions from each stack below 40 per cent opacity, or to distribute the effluent over two or more stacks placed in such close proximity that it is impossible to make a smoke reading from either. A Rule 60 violation is also involved when visible emissions are otherwise rendered invisible before discharge into the atmosphere by such methods as heating contaminants in the source system above the dewpoint, dilution of emissions by means of blowers and fans, etc.

F. *Noncompliance with Emergency Regulation and Alert Instructions*

The purpose, scope and administration of Regulation VII, Emergencies, are described in Chapter 3, Law of Air Pollution Control. For a complete and accurate understanding, this regulation should be studied in the official Rules and Regulations of the A.P.C.D. Here we shall consider only the rules which require immediate action on the part of the enforcement operation. (The rules quoted here are condensed and paraphrased.)

Rule 161 of Regulation VII, EMERGENCIES, states that "When an alert has been called the Air Pollution Control Officer, the Sheriff, their deputies, and all other peace officers within the Basin shall enforce the appropriate provisions of this regulation and all orders of the Air Pollution Control Board or the Air Pollution Control Officer made pursuant to this regulation against any person who, having knowledge of the declaration of an alert, refuses to comply with the rules set forth in this regulation or any order of the Air Pollution Control Board or the Air Pollution Control Officer made pursuant to this regulation"

To enforce this regulation, the Enforcement Division of the A.P.C.D. maintains an accurate record of air contaminant readings as received directly by landline from the Air Monitoring Control Center so that it may alert all enforcement personnel to approaching alert stages. When an alert level is reached, the Enforcement Division acts in accordance with its administratively assigned role which is, in part, dictated by the following Rules:

> RULE 155, DECLARATION OF ALERT. The Air Pollution Control Officer shall declare the appropriate "alert" whenever the concentration of any air pollution contaminant *at any* sampling station has been verified to have reached an amount set forth in Rule 156.

RULE 156, ALERT STAGES FOR TOXIC AIR POLLUTANTS.

(IN PARTS PER MILLION OF AIR)

	FIRST ALERT	SECOND ALERT	THIRD ALERT
CARBON MONOXIDE	100	200	300
NITROGEN OXIDES	3	5	10
SULFUR OXIDES	3	5	10
OZONE	0.5	1.0	1.5

FIRST ALERT: Close approach to maximum allowable concentration for the population at large. Still safe but approaching a point where preventive action is required.

SECOND ALERT: Air contamination level at which a health menace exists in a preliminary stage.

THIRD ALERT: Air contamination level at which a dangerous health menace exists.

RULE 155.1, NOTIFICATION OF ALERT. Following the declaration of the alert, the Air Pollution Control Officer shall notify: the Sheriff's office and substations; city police department; California Highway Patrol; local public officials and public safety personnel; air polluting industrial plants and processes; the general public; all Air Pollution Control District personnel.

The Enforcement Division is specifically responsible for contacting all law enforcement agencies, all A.P.C.D. field personnel via radio, and all air polluting industrial plants and processes. The Sheriff's department so notified contacts all local public officials and public safety personnel. The Public Information Division of the District contacts all Civil Defense personnel and communication media—press, radio, television, etc.—by landline and by teletype.

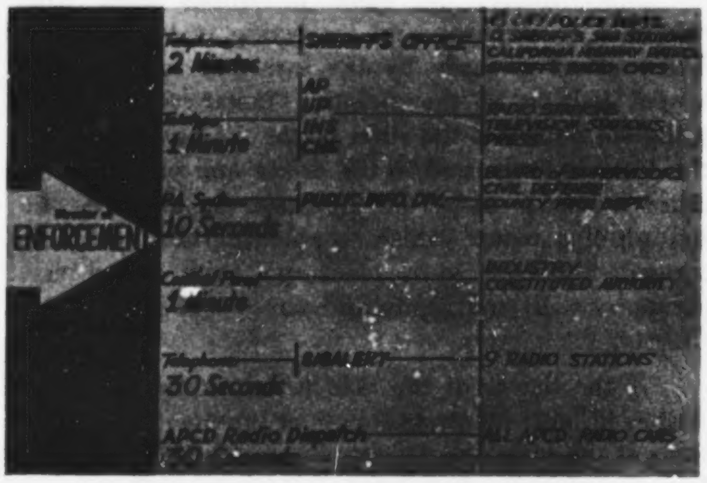


Figure XIII - 12. Alert notification system.

The air polluting industries are contacted by means of selective call facilities located in the Enforcement Division Communications Center.

> RULE 155.2, RADIO COMMUNICATION SYSTEM. This rule requires the Air Pollution

Control Officer to install and maintain a radio transmitter for the purpose of broadcasting the declarations of alerts and information and instructions. This rule also requires certain specified categories of industrial plants to install radio receiving equipment with decoding devices capable of receiving broadcasts from the Air Pollution Control Officer of the declaration of alerts, information and instructions.

1. Enforcement of Regulation VII

The principal provisions of Regulation VII enforced are Rule 154.1, requiring submission of shutdown plans from air polluting industries, Rule 155.2, requiring installation of radio receiving equipment by specified air polluting industries, Rule 157, First Alert, Rule 158, Second Alert, and Rule 159, Third Alert, and any "order of the Air Pollution Control Board or the Air Pollution Control Officer made pursuant to this regulation" as stated in Rule 161. Rules 154.1 and 155.2 are administratively enforced, that is, they do not normally involve the field inspector as they are handled in terms of compulsory submission of shutdown plans. Persons failing to submit plans within 60 days after they have been officially requested can be prosecuted under this regulation. Rule 154.1 is quoted in part here to reveal this procedure:

> RULE 154.1, PLANS. a. (Revised 7-26-56). If the Air Pollution Control Officer finds that any industrial, business or commercial establishment or activity emits hydrocarbons or any of the contaminants named in Rule 156, he may give written notice to the owner or operator of such industrial, business or commercial establishment or activity to submit to the Air Pollution Control Officer plans for immediate shutdown or curtailment, in the event of an air pollution emergency, all of the sources of hydrocarbons or any of the contaminants named in RULE 156, including vehicles owned or operated by such person, his agents or employees in the scope of the business or operation of such establishment or activity. Such plans shall include, in addition to the other matters set forth in this rule, a list of all such sources of hydrocarbons and any of the contaminants named in RULE 156, and a statement of the minimum time and the recommended time to effect a complete shutdown of each source in the event of an air pollution emergency. Such notice may be served in the manner prescribed by law for the service of summons, or by registered or certified mail. Each such person shall, within sixty (60) days after the receipt of such notice, or within such additional time as the Air Pollution Control Officer may specify in writing, submit to the Air Pollution Control Officer the plans and information described in the notice.

The enforcement procedure and the data gathering activities involved in enforcing Rules 157, 158, and 159 are dependent upon the conditions which obtain during the state of emergency and the exact nature of the orders given by the Air Pollution Control Officer.

a. "Standby" Alert

When any contaminant reading closely approaches the first alert level, the field inspectors are notified by radio to "stand by" and to remain on the air. During a "standby" alert inspectors refrain from making any investigations, unless specifically ordered to do so by the Communication Dispatcher. The inspector then waits for further instructions, and for cancellation of the "standby" alert, or a calling of the First Alert.

b. Rule 157, First Alert

The first alert itself is a "warning" alert. When called, upon the order of the Director of Enforcement or his authorized agent, the field inspectors are notified as follows:

> "All Units. A first alert has been called. Repeat — a first alert has been called. All units will take the appropriate action provided for in Rule 157. All units acknowledge."

A parallel message is delivered to the Regulation VII industries over the selective-calling facilities.

The field inspectors acknowledge when their unit number is called. All field personnel then remain on the air and stand by for any further instructions.

During a first alert, it should be noted, no burning of combustible waste material is allowed in open fires and incinerators, except in an approved multiple chamber incinerator, and those which are required by law for the disposal of certain types of waste materials, i.e., hospitals, sanitariums, etc. (see Rule 162).

Inasmuch as Rules 57 and 58 outlaw all open burning and incinerators (all types of open burning are outlawed on days when an alert occurs) operators can be cited under either Rule 57 or 58, whichever is the case, as well as Rule 157. The effect of Rules 57 and 58 has been, however, to reduce the necessity of Rule 157 enforcement during alert periods.

c. Rule 158, Second Alert

In the event the toxic concentration of air pollution continues to rise and a second alert is necessary. the action provided for in Rule 158d may require the curtailment or complete shutdown of business and industry, and the maximum restriction of vehicular traffic.

Rule 158 describes a "preliminary health hazard alert". The specific action to be taken by field inspectors is dependent upon the nature of the instructions to be received from the air pollution control officer. For both the second and third alerts, field personnel may be called upon to conduct supplementary on-the-spot sampling, visit air monitoring stations, verify shutdown, coordinate curtailment of vehicular traffic, and perform messenger and communications services as required. (See Emergency Response Capability, Chapter 6.)

d. Rule 159, Third Alert

Rule 159 describes a "dangerous health hazard". The specific action to be taken by field inspectors is dependent upon the nature of the instructions to be received from the air pollution control officer.

2. End of Alerts.

The Air Pollution Control Officer declares termination of the alert when the concentration of any contaminants which caused the calling of the alert falls below the Rule 156 standard.

Termination of the alert is broadcast to all units by the Radio-Telephone Operator upon direction of the Director of Enforcement or his authorized agent.

III COMPLETING AND SERVING NOTICE FORMS

The data constituting the elements of the corpus delicti are accurately completed on the appropriate investigative report (see Chapter 6, "Reporting Results of Inspection"). These data are essentially the same for all of the forms used though they are treated and disposed of according to the action initiated. In the case of violations, each Notice contains a statement which charges the person responsible for the violation with committing a misdemeanor. This consists of a standardized completion statement which is used to charge the person with a violation of the pertinent section of the State Health and Safety Code or the Rules and Regulations, or both, if multiple violations are involved. A blank is provided for the insertion of the appropriate section numbers violated and space is provided to enable the inspector to complete the wording of the charge. When the Notice is issued on the basis of the Rules and Regulations, the wording of the charge pertaining to the state law is crossed out and replaced by the wording of the rule. The procedure for the Citation is somewhat different (see "Motor Vehicles" in previous part of this chapter).

Once the Notice of Violation is written in duplicate, the yellow second sheet of the Notice is served to the person most responsible, i.e., the person in highest authority. The first copy, the pink Notice, with the "Findings" on the reverse side completed, is brought to Headquarters for review and action. The Notice is served according to the following conditions:

A. If the responsible person refuses the Notice, the inspector may leave the Notice on desk or any portion of the premises of the source in view of the responsible person, or the Notice may be brought to Headquarters for mailing.

B. If no responsible person is on the premises and location of the responsible person cannot be obtained, return the Notice to Headquarters for service by other means.

C. If no responsible person is on the premises and another location for the responsible person is obtained outside of the inspector's sector, forward the Notice to the appropriate section inspector via Headquarters.

D. If the owner resides outside of Los Angeles County and there is a manager being compensated for his services, the Notice should be left with the manager.

E. If the owner resides and works outside of Los Angeles County and no manager lives on the premises, return the Notice to Headquarters for service by mail.

CHAPTER FOURTEEN

REGISTERING THE SOURCES OF AIR POLLUTION

The immediate goal of registering the sources of air pollution is to place in the files of the control agency a record of each piece of equipment in the pollution zone capable of emitting air contaminants. The data compiled must be sufficient to enable an analytical engineering review, so that air pollution potentials and statutory compliance can be determined, as follows:

REGISTRATION REQUIREMENTS

INVENTORY DATA

1. **Corporate or individual ownership or responsibility.**
2. **Location of the equipment source.**
3. **Complete identification and description of the equipment, including all important constituents, appurtenances and devices which affect the emission of air contaminants.**

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ENGINEERING REVIEW DATA

4. **All data relevant to expressing the air pollution potentials of the equipment, such as nature of process, size of outlets, rate of emission, composition of effluent.**
5. **Actual and potential degrees of compliance with the air pollution laws.**

The amount of information required to accomplish an equipment and operation analysis will obviously vary among equipment units. Complexity, size of pollution potentials and other variables must be taken into account. In order for the registration process to efficiently cope with the magnitude and diversification of all of the equipment units which may be found in the pollution zone, and the changes which take place in both of these with time, information standards must be adapted to the following rough groupings of equipment:

1. MAJOR SOURCES OF AIR POLLUTION:
   All sources of air pollution which require extensive design and operational information, as well as field tests, such as power plants, process units within refineries, large metallurgical furnaces, municipal incinerators.
2. TOTAL SOURCES OF AIR POLLUTION:
   All equipment units and processes whether minor or major sources of air pollution, mobile or stationary, which must be accounted for in making total pollution surveys.
3. PERMIT-REQUIRED SOURCES OF AIR POLLUTION:
   All equipment and processes which require a permit from the A.P.C.D. These will require a definite minimum quantity of information as specified by the control agency before permits are granted or denied.
4. PERMIT-EXEMPT SOURCES:
   Equipment and processes which may be minor sources of air pollution but which are legally and administratively exempted from permits. The amount of information required for this equipment should be far less than most of the equipment involved above.

Minor sources, for example, should require less information, especially when the design characteristics of standard equipment — such as some types of incinerators or spray booths — are well-known. To register permit-exempt sources it is sufficient to obtain points #1, #2 and #3 of the Registration Requirements only. Permit-required equipment, on the other hand, will require the satisfaction of all registration requirements and, in particular, points #4 and #5, i.e., plans, specifications and other engineering data as will permit a practical review of equipment design and operational capabilities as they affect air pollution potentials.

It should be noted that the difference in the facility of gathering infomation for the first three points of the Registration Requirements, and points numbered four and five, as indicated by the arrow cut-off point above, is considerable. For example, an inspector can enter a plant and readily determine by interview and observation corporate and individual responsibility, the location of the equipment source, and the identification and description of the equipment. He cannot, however, accurately determine the size of outlet, flow rates of effluents, design characteristics, etc., necessary to calculate quantitatively the rates of emission under both normal and a variety of operating conditions. This can only be done by a studied analysis of plans, specifications, design, operation, process materials and fuels.

On the basis, then, of the applicability of each source of emission to the permit system, we may divide responsibility for registering the sources of air pollution into two distinct, but complementary phases:

1. Inspection and inventory of all of the sources of air pollution to satisfy the first three registration requirements.
2. Administration of the permit system, i.e., processing applications for A.P.C.D. permits.

The Enforcement Division of the A.P.C.D. locates and identifies all equipment sources of air pollution in all industrial, commercial and governmental establishments in the pollution zone, whether they are minor or major, permit-exempt or permit-required. The process consists of preparing Equipment Lists for each industrial, commercial or governmental address-location. For each equipment unit entry, the permit status is noted. This is a designation of compliance with respect to Rule 10, *Permits Required*. Equipment units which are sources of pollution and in operation without required permits are either cited under Section 24279, in the case of flagrant violations, or A.P.C.D. Permit Requests are issued to force direct permit application. Thus the inventory inspection generally leads to the second phase of the registration process, the filing of permit applications.

The Engineering and Evaluation and Planning Division of the A.P.C.D. administers the permit system by receiving and reviewing applications, and issuing *authorities to construct* and *permits to operate* for equipment which meets control standards or denying such approval when these standards are not met. The applications received may arrive as a result of the inventory process above, or are submitted voluntarily by responsible and cooperative plant managers. As a matter of fact, the effectiveness of the inventory process can be directly related to the increase in voluntary applications for permits in the pollution zone, since the number of "voluntary" and "compulsory" applications filed with the control agency are both directly proportional to the amount of inventory activity. Overall compliance with the control authority can be similarly related to the inventory activity.

Because the inventory is a function of field control operations, and the review of permit applications an engineering function, we shall deal mostly with the former.

I THE EQUIPMENT INVENTORY

An inventory is an accounting device employed in the administration of a business. It is a means of taking "stock" of the categories of merchandise, the number of "items" in each category, and the purchase price. This information is necessary in computing the assets of a company. It is of value to the accounting operation only to the degree that an accurate and *complete* record is made. A partial or incomplete inventory of any stock is of relatively little value.

In general, the inventory employed in air pollution control enforcement is an accounting method employed to enforce compliance with the permit system and, ultimately, the Rules and Regulations of the A.P.C.D. It is also a statistical device for comparing source growth and determining air pollution potentials. Like the accounting inventory, the value of the enforcement inventory depends directly on its completeness of application.

In the enforcement inventory, however, it is necessary to recognize the limitations of an *area inventory*, as opposed to that of an individual enterprise, with respect to the possibility for completeness. The area inventory is an attempt to obtain a complete inventory of all of the equipment units capable of air pollution in the pollution zone at any one time. The completeness possible is problematical, and depends on whether the number and kinds of sources of pollution in the pollution zone are "infinite" or "finite" with respect to the inventory capability of the control agency. An area inventory is *infinite* when the inventory capability is such that not all of the sources of air pollution can be inventoried at any one time. The categories and number of individual items contained in the pollution zone may be so large that before any inventory cycle is completed, that is, before all of the establishments in the zone are inspected, the numbers and categories of pollution have undergone significant change. In such cases, the area inventory must be a form of *perpetual inventory*, as opposed to the *calendar* or fiscal inventory, which is a complete inventory of items made within a specified inventory period. The inventory of a single establishment, on the other hand, represents a record of a "finite" number of sources, since changes in the number and kinds of sources generally do not take place either during or immediately after the taking of the inventory. The *plant* or *activity* inventory for each address-location may be planned on a periodic, calendar or fiscal inventory basis, even though the area inventory cannot be simply treated in this fashion.

In an area the magnitude of Los Angeles County containing about 16,000 establishments with stationary sources of air pollution*, the number of sources is large and variable, and the inventory record can never truly be said to be complete. How can such inventories be administered so that the information on hand is reasonably representative of the pollution zone? How valid is the data now in the files covering equipment which has been inventoried in the initial part of the current inventory cycle? How many sources of air pollution in the pollution zone comply with the permit system, and how many do not at any given time? The answers to these questions involve the development of an efficient perpetual inventory system based on an optimum inventory cycle or inspection frequency.

The time interval between inventory and reinventory of each of the industrial establishments in the pollution zone may be referred to as the *inventory cycle*. It can be said that the area inventory is of little value, if the inventory cycle is overly long. Both pollution potentials and degree of compliance from such an inventory cycle cannot be reasonably extrapolated at any one time, since many changes affecting gross pollution potentials and mass compliance have probably taken place in the interim. On the other hand, a monthly inventory reinspection, while guaranteeing continuous up-to-date information, would require an excessive number of enforcement personnel.

The optimum frequency of inventory reinspection should thus reflect some compromise which bears a significant control force, and which minimizes the margins of error of current inventory information. As will be recalled, there is a frequency of inspection (or length of inventory cycle) which may not only accurately reflect conditions of industrial turnover, but may discourage an operator from taking calculated risks, especially with respect to the permit requirements. In fact, permit infractions can result in serious risks on the part of management, since investment in equipment discovered to have been constructed and operated illegally may be lost.

Each control agency must determine for itself the optimum frequency of inventory. Such criteria as the size of the air pollution potential itself, the number of equipment units at each address-location, and the general complexity of the plant may be taken as criteria for determining the proper inventory inspection cycle, for example:

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* We are omitting from consideration motor vehicles and other mass domestic sources of air pollution such as incinerators, open-fires, gas-heaters, stoves, etc., as such inventories are arrived at by population statistics, and the control of these sources is accomplished by other means.

1. Air Pollution Potential: Industrial or commercial establishments with a relatively large air pollution potential should be inspected frequently, since any change, however subtle, may affect that potential.
2. Number of Equipment Units and Complexity of Plant: Industrial establishments containing a large number of equipment units or complex processes possess a greater tendency for change, and hence are subject to permit infractions. These should be inspected frequently.

In Los Angeles County, where saturation coverage is required, the basic frequency of inspection for average industrial or commercial establishments is once each year. More significant establishments, those with large air pollution potentials and many equipment units, are inventoried two and even three times per year. On the other hand, some small or commercial establishments such as warehouses, automobile dealers, supermarkets with single pieces of equipment (multiple-chamber incinerator or spray booth, etc.) whose use and design are not likely to change or which emit small amounts of air pollution, or other establishments with no sources of air pollution or no expansion potential, are inspected less than once each year, or at the discretion of the field inspector.

Needless to say, plants inspected on an optional basis should be inspected within a reasonable period of time. Depending upon work loads which may engross field time in other control problems of higher priority, such sources should be inspected within a reasonable period of time.

A. Functions of the Inventory System

The air pollution control enforcement inventory may be further distinguished from the business inventory by the specific functions it must perform. These are (1) categorization and itemization, (2) enforcement of the permit system, (3) determination of air pollution potentials, and (4) determination of work load and organizational strength. Where saturation coverage is required, as in Los Angeles, the inventory system is employed for multiple purposes to maximize the utility of the data.

1. Categorization and Itemization

The inventory system employed should be capable of itemizing and categorizing all sources of air pollution relevant to the air pollution potential of the community. The categories employed are major subdivisions or groupings of equipment or activities basic to the pollution problem and comprising the industrial economy. A community experiencing only a smoke problem may employ a finer categorization of combustion equipment for the purpose of comparing relative contributions of smoke, than will a community with a more varied type of air pollution problem. In the case of the former, boilers and incinerators might be categorized by horsepower, combustion chambers, fuel used, etc., while other sources of air pollution are ignored. The more complex the contributing industrial economy, however, the greater and more varied will be the number of categories of the sources or activities producing air pollution.

Itemization refers to the number of individual or other subgroupings of the sources of air pollution (such as activities, plants, or processes) which may be found in each of the relevant source categories. Itemization may be used for statistical compilations, or for reference as in "2" below.

2. Enforcement of the Permit System

The inventory can be used as an enforcement tool in two basic ways: (a) to locate all equipment which has or which does not have valid permits or licenses to operate, in order to bring all equipment in the pollution zone in compliance with the control authority, and (2) to assure uniformity of treatment in obtaining compliance. The inventory record may be used both as a field reference file carried in the vehicles of sector inspectors, and as a headquarters file for use in selective and statistical analyses. Each inventory thus constitutes a reference for future inventory checks and compliance determinations.

3. Determination of Air Pollution Potentials

In an inventory system, the equipment capable of emitting air pollution may be categorized and itemized so as to provide accurate statistical data necessary to compute the air pollution potentials of the source categories, individual equipment or plants, and the entire industrial economy. In the case of individual pieces of equipment, the determination of air pollution potentials is necessary in ascertaining compliance or non-compliance with the legal authority. In the case of the relative contributions of the categories, and of the pollution potential of the entire industrial economy, data will reveal what progress has been accomplished as a result of the control program, and, conversely, what remains to be done to control the uncontrolled sources. The inventory system thus contributes to a continuous or cumulative record of the present, past and future, and can be used to compare progress or growth of sources.

The inventory system should yield such factors or units along with established emission factors as will enter into a computation of the various air pollution potentials. For example:

Air Pollution Potential in weight units per day of a given category of equipment = No. Controlled units × emission factor for controlled units
+
No. Uncontrolled units × emission factor for uncontrolled units

Thus the inventory system may participate in establishing a meaningful basis for prohibition by demonstrating conclusively before legislative bodies what would be accomplished by such prohibition. In testimony made before a legislative body on behalf of proposed rules, it is necessary, for example, to determine how many sources of air pollution are in the category to be affected by a proposed prohibition, what the total air pollution and nuisance potentials are, their relationship to the overall air pollution problem, how they can be controlled to meet the standards in the proposed rule, the cost of control, and an overall estimate of the feasibility of such control. Such a record also serves as a basis for modifying rules or prohibitions which are not in keeping with newly disclosed air pollution potentials.

In ascertaining the air pollution potential of each source of air pollution, the inspector is of the utmost importance. The potential cannot always be determined by a premeditated type of inventory record, but often must be presented in terms of an original organic description of equipment, the quality of which depends on the inspector's training, background, powers of observation, and understanding. Therefore, inventory systems must provide not only for the compilation of certain standard categories of information, but also for adaptation of information to unpredictable situations. It is frequently most important for the inspector to determine the air pollution potential through his own devices rather than conform to strict procedures which engineer the information required.

4. Determination of Work Load and Base Line of Enforcement Actions

The inventory system lends itself as a basis for determining work-loads, sector assignments and forecasts of man-hour availability for the purpose of maintaining a balanced saturation and selective coverage program. Inventories directly disclose the number and kinds of industrial establishments which must be reinspected, and, by correlation with Inspectors' Daily Reports, the average time required to inspect each of them. The inspection time may be expressed in terms of a standard inspection unit, or time factor unit. In the A.P.C.D., an *inspection unit* is an expenditure of 15 minutes of continuous inspection time. The assignment of inventory reinspections weighted by inspection units has the effect of balancing priorities in practically all phases of the field operations program, thus providing an indirect "base-line" from which the increase or decrease in such enforcement actions as the number of Written Notices and Citations issued, the number of new and revised Equipment Lists, the number of court cases filed and completed, etc., reliably indicates trends in compliance.

B. *Types of Inventory Systems*

The selection of an inventory system depends on the requirements of the field operations program. Since emphasis on one function may mean compromising or sacrificing another, each of the possible systems described below possesses certain inherent advantages and disadvantages. For example, the inventorying of equipment to obtain reference data for the enforcement of a permit or license system may be accomplished at the expense of accurate, specific air pollution potential data.

It is perhaps unwise to place the burden of obtaining all field data which may be required by the control agency on the inventory system. Total pollution studies should be compiled from other sources of information, such as census statistics and market information. The inventory system, therefore, should be limited to as few manageable functions as possible.

1. Cumulative Alphabetical-Chronological

This is a cumulative dossier file of all records and documents which may pertain to each establishment, filed alphabetically by the name of the establishment, and chronologically by the dates reports enter the file. Inventory records, permits, or licenses, permit applications, inspectors' reports, variances, court and Hearing Board records, etc., are maintained in chronological order within each file record. The whole system, being alphabetically arranged, will require a cross-index card system in order to compile from the master record any categories of data or sources of air pollution required for any given purpose by the agency.

The advantage of such a system is that it establishes one central filing system. The inventory record is, in fact, compiled from many sources of information rather than from just inspection. In this way, the multiplicity and duplication of filing systems and operations are eliminated.

The disadvantages may consist in lack of uniformity and consistency in coverage, and the fact that the inventory records as such are "hidden" and must be gleaned whenever required. Because the inventory information is not grouped to meet the requirements of categorization and itemization, auxiliary reference files are required. Other forms of administrative control may be required to maintain consistency, usefulness and accessibility to the information.

2. Equipment Classification System

This is an inventory system based directly on the filing of categories of equipment units which may be legal sources of air pollution, and then alphabetically by name of company operating such equipment. In this system equipment classifications may be developed which are relevant to both determining air pollution potential and case histories of the sources. For example, categories might encompass such types of equipment as "afterburners", "absorption towers", "boilers", "incinerators", "shakers", etc. The file of this type of inventory system is capable of yielding instantly the amount of equipment in a precise category of sources of air pollution. The information has direct and continuous impact in maintaining accurate statistical analyses of the pollution potentials of the community.

It provides at any given time the amount of equipment in each category, the companies operating the equipment, location, and the amount of equipment controlled and uncontrolled.

A disadvantage of such a system is that the number of categories is probably excessive and indefinite. Problems always arise as to where a given piece of equipment belongs, or how it is to be classified. Some equipment does not fit conveniently into established categories as they appear in a changing technology. Perhaps the most important disadvantage is that it is cumbersome for an inspector to make separate inventory records on each category or source of air pollution, especially in a large plant containing many pieces of dissimilar equipment. Also, to acquire information concerning all of the equipment which may be contained in any one industrial plant may require that either the files be gleaned painstakingly or that another master record system be developed. This system, thus, does not lend itself well to multiple uses of data.

3. The Activity Classification System

This is an inventory system based primarily on a comprehensive categorization of the *technological activities* which make up the industrial economy of the pollution zone. These activities include such industrial classifications as "metallurgical or metal melting and reclaiming", "petroleum and petrochemical", "industrial chemical manufacturing, etc." Industrial plants, commercial enterprises and governmental establishments are appropriately grouped within such technological activities, and classified and filed accordingly. Each unit of inventory, that is, the Equipment List, is made up of all the equipment units comprising a particular activity at one address-location. If an industrial enterprise conducts several technologically distinct activities, such as metal melting (foundry) and metal plating (surface coating) at one address-location, an individual inventory for each activity is made at the address-location. This system lends itself fairly well to the logical accounting procedure which would be naturally employed by the inspector, since the inspector is interested in production cycles, production objectives, and material and product volumes of a complete activity.

The activity classification system may be primarily concerned with determining compliance with respect to the permit system, since itemization on Equipment Lists lends itself to permit status reference, rather than to statistical compilations of equipment units. There are several distinct advantages to such a system which relate to the multiple uses which can be made of the data developed by this system. For one thing, because the inventory system is based on that activity which would occupy the inspector's interest during one inspection, it provides a *work unit*, a basis for distributing work loads and scheduling inspections. Secondly, it lends itself well for sector analyses in the location of all activities which may contribute to a nuisance or air pollution problem. Thirdly, it develops the number of industrial plants (or activities) which make up the air pollution potential of any technological classification in determining the relative contribution of an industry to the overall air pollution problem.

The activity classification system is described in greater detail later in this chapter, as it is the procedure employed by the Enforcement Division of the A.P.C.D. Its use permits the development of a limited dossier inventory file, built up from *Activity Status Reports* submitted subsequent to the original Equipment List inventory. (See also "Maintaining Record Systems" in Chapter 6.)

Several disadvantages to this system derive from the fact that it does not break the sources of air pollution, that is, the equipment units themselves, down into statistically useful classifications as does the equipment classification system above. The broad technological classifications employed in an activity system tend to be nebulous. Questions may arise as to the location of specific units and operations in the overall inventory record system. Moreover, it is administratively difficult to compute the number of equipment units in equipment categories from Equipment List files. It thus cannot be used for evolving units or factors for determining air pollution potentials or for directly determining the number of controlled and uncontrolled equipment in any given category. Secondly, it separates a number of integrated activities which might be found at one address-location into activities which have remote positions in the file, thus requiring a reference finding file to recombine the activities back into address-locations, or the use of special files.

* * * *

Despite disadvantages which may be found in any system, all are possible, and all may achieve sound results provided that proper administrative control is maintained over the records and a high quality of field activity is achieved through training and constructive supervision. Many systems require cross-referencing to various other informational files. Activity based files, furthermore, can be coded and otherwise referenced for convenience, especially in connection with selective analysis. Data can always be translated or converted from one form to another in any system.

C. *Source Coverage of Inventory Inspections*

Source coverage refers to the extent or completeness with which all sources are inventoried in the pollution area. A procedure of source coverage must be developed for inventorying the sources of air pollution which will compensate for the incomplete data resulting from a perpetual inventory system. Source coverage may be *random* or *scheduled*, or a combination or sequence of both. In *random* source coverage, the source-locations within any inspection sector are inspected at the inspector's discretion. Although the inspector may systematically schedule his own inspections according to a strategy he has adopted for that sector, the inspections conducted in all sectors of the pollution zone are still randomized. Random inspection is in a sense equivalent to a painter who employs the technique of working the "whole canvas at once". The design or composition of such a canvas becomes readily apparent much sooner than in the case where the artist proceeds from one of the corners and works systematically from that point without any break in the emerging continuity. Similarly, the practice of random inventory occurring simultaneously in each of the inspection sectors of the area discloses an industrial source pattern from which pollution potentials and mass compliance can be reasonably extrapolated. Here again the initiative of the inspector and the quality of his work in his sector is statistically of the utmost importance.

On the basis of the initial inventory inspections, *reinspections* can then be scheduled or planned. The scheduling accomplishes control over consistency, uniformity, non-repetition, etc., in order that the data in the files at any given time possess the highest degree of completeness and accuracy possible under the circumstances.

We may then speak of source coverage as employed by the A.P.C.D. in terms of the random (1) initial inventory inspections, and the scheduled (2) inventory reinspection.

1. Initial Inventory Inspections

The initial random inspection is conducted at a plant for which no previous inventory inspection has been conducted. We shall assume here that a sector is being approached for the first time to locate all *address-locations* where sources of air pollution may be found.

It is obviously not wise to merely inspect plants on a block-by-block basis, since valuable time is wasted on many inconsequential sources of air pollution. To maximize the usefulness of all field control operations, it is best to conduct inventory inspections first in those plants complained about, those responsible for visible emissions, citizens' complaints, and those involved in public nuisances, variances, or violations of the law. All plants actively involved in enforcement actions should be carefully inventoried as a part of the practice of enforcement at those plants. Those industries whose air pollution potentials are quite obvious to one observing them from a patrol, such as foundries, steel mills, etc., should be inspected next. Industries under construction, or those which appear to have been just recently completed, or appear to have been involved in a change of ownership should be inspected, since all equipment units capable of air pollution in such plants immediately come under the jurisdiction of the permit system. Information as to where new construction or changes in ownership may be taking place may be obtained from the Business License Bureau, and/or from business lead services. And, finally, the inspector should locate all of the industrial communities or areas of high source concentration in his sector, first inspecting those sources which appear to be more important and so on. The final completeness of coverage may be checked against the yellow pages of the telephone directory, which lists industries in categories similar to those employed by the control agency.

Of course, each inspection sector may call for a different emphasis in coverage. In the downtown area, for example, where virtually every office building has a heating or steam generating plant with oil-standby facilities, it is desirable to contact all boiler operators on a block-by-block basis. Because of the complexity of the petroleum industry, unit processes must be inspected systematically and periodically in sectors containing petroleum industries. In other sectors, inspectors may be concerned primarily with one or another type of industry predominating in that area.

An inspector who has become familiar with his sector will have accumulated an excellent knowledge of not only the principal types of source activities, but the names and histories of the industrial plants. When an inspector changes sectors and encounters industries with which he is unfamiliar, he can consult the A.P.C.D. library for any information he may require. An excellent method of familiarizing oneself with any industry is to concentrate inspections in that industry for a short time.

2. Inventory Reinspections

In the A.P.C.D., all subsequent inventory reinspections are scheduled. The frequency of inventory inspection is determined from the findings of the initial inspection and the inspector's recommendations. The schedules are typed up monthly for each inspection sector and are forwarded to the sector inspector. The sector inspector then schedules these reinspections so that he can complete them within a month. The number of reinspections assigned per sector are based on the fact that all annual, semi-annual, and tri-annual inspections (the inventory cycle) must be completed within one year.

The inspector, however, may have occasion to inspect plants out-of-schedule because of complaints or violations. In such instances, the inspector does not make a formal inventory reinspection, but uses the copy of the inventory record (Equipment List) from his files as a check on the permit status as well as the description and operation of the equipment. When a specific kind of an air pollution problem is involved, it is best to concentrate on that problem rather than on the inventory of the entire plant. However, formal change can be made on the Equipment List during an unscheduled inspection if the Equipment List itself can be used as a tool in gathering evidence. Especially

TABLE XIV - I.

PRIMARY ACTIVITY CLASSIFICATIONS

PETROLEUM AND PETRO-CHEMICAL DEVELOPMENT, PROCESSING AND MARKETING - 01

1. Refineries
2. Bulk Gasoline Marketing Facilities, Rule 61 Actual or Potential
3. Petroleum Production and Related Operations
4. Bulk Storage of Petroleum Distillates, Rule 56 Tank Farm and Marine Terminal
5. Asphalt Manufacturing and Felt Saturators
6. Heavy Hydrocarbons e.g. Blending, Compounding and Marketing of Fuel Oils, Asphalt, Grease, Lube Oils, Road Oils, etc.
7. Re-refiners, Solvents and Lube Oil
8. Petro-Chemical Manufacturing
9. Sulfur Recovery Plants

INDUSTRIAL CHEMICAL MANUFACTURING AND PROCESSING (EXCLUDING PETRO-CHEMICAL) - 02

1. Soaps and Detergents
2. Insecticides and Herbicides, Compounding and Packaging
3. Chemical Specialties e.g. Compounding and Packaging of Pharmaceuticals, Cosmetics, Aerosols, Household and Janitorial Chemicals, etc.
4. Industrial and Automotive Chemicals
5. Manufacturing and Packaging of Gases
6. Explosives, Rocket Propellants and Pyrotechnics
7. Radio Active Materials, Isotopes and Related Materials
8. Chemical Processes Involving Chlorination
9. Catalysts
10. Organic Chemicals
11. Inorganic Chemicals

PAINTS AND RELATED MATERIALS, MANUFACTURING AND HANDLING - 03

1. Paint Type Products e.g. Lacquer, Varnish, Shellac, Ink, Enamel, Powder Paints, Water Emulsion Paints, etc.
2. Paint Additives e.g. Pigments, Dryers, Surfactants, etc.
3. Polymers and Resinous Materials
4. Marketing of Solvents and Liquid Chemicals
5. Vegetable and Animal Oil Processing (excluding Rendering and Food Processing)
6. Adhesives e.g. Sealants, Putties, Calking Compounds, Masking Compounds, etc.

PLASTIC, RUBBER AND RESIN PROCESSING - 04

1. Rubber Products Processing e.g. Molding, Dipping, Coating, etc. (excluding Tires)
2. Rubber Reclaiming
3. Tire Recapping
4. Plastic and Resin Molding e.g. Injection Molding, Compression Molding, Extrusion Molding, Permanent Molding, etc.
5. Plastic and Resin Fabrication e.g. Laminating, Casting, Embedding, Sheet Forming, etc.
6. Tire Manufacturing

METAL MELTING AND RECLAIMING - 05

1. Grey-Iron Foundry Facilities
2. Steel Foundry Facilities
3. Brass Foundry Facilities
4. Aluminum Foundry Facilities
5. Magnesium Foundry Facilities
6. Miscellaneous Non-Ferrous Foundry Facilities
7. Secondary Refiners
8. Core Making Facilities
9. Die Casting Facilities

METAL FABRICATING - 06

1. Electrical and Electronic Equipment Manufacturing
2. All Instrument Manufacturing, Repairing and Rebuilding
3. Structural Metal Fabricating and Forming
4. Sheet Metal Fabricating e.g. Punch Pressing, Drawing, Metal Spinning, Tube Drawing, etc.
5. Welding, Blacksmithing, Forging, Swaging, Cold Heading, Upsetting, etc.
6. Heavy Machinery Manufacturing and Reconditioning
7. Metal Cutting e.g. Machine Shops, Tool and Die Shops, Oil Tool Manufacturing and Reconditioning, etc.
8. Battery Manufacturing, Assembling and Rebuilding
9. Wire Products Manufacturing e.g. Springs, Cables, Wire Forms, Metal Cloth, Wire Drawing, etc.
10. Powdered Metal Processing

SURFACE FINISHING AND COATING - 07

1. Galvanizing Facilities and Plants including Dip Tinning
2. Sand Blasting and Abrasive Blasting Facilities
3. Heat Treating Plants
4. Printing on Metal
5. Plating Facilities
6. Surface Coating and Protective Treating of Materials e.g. Pickling, Parkerizing, Bonderizing, Corrosion Preventive Coatings, Vacuum Coating, Metallizing, Anodizing, etc.
7. Surface Grinding and Polishing e.g. Centerless, Surface, Lapping, Honing, etc.
8. Painting and Enameling, Major Users
9. Display Sign Manufacturing and Servicing

MINERAL PROCESSING - 08

1. Sand and Gravel Plants, Rock Plants, Concrete Batch Plants, Cement Storage and Handling Facilities
2. Asphalt Paving Plants e.g. Hot Plants
3. Ceramic Processing e.g. Brick, Tile, Clay Products, Refractories, etc.
4. Glass, Frit and Rock Wool Manufacturing, including Vermiculite and Perlite Plants
5. Mixing, Grinding, Blending and Packaging of Miscellaneous Mineral Base Products

WOODWORKING AND FURNITURE MANUFACTURING - 09

1. Lumber Yards, including Sash and Door Mills
2. Furniture Manufacturing, Repairing and Refinishing, including the Use of all Materials
3. Casket and Cabinet Shops
4. Wood Treating Facilities e.g. Termite Proofing, Creosoting, Flame Proofing, etc.
5. Pattern Shops, all Types
6. Wood Turning Facilities
7. Wooden Shipping Materials e.g. Pallets, Crating, Skids, Cooperage, etc.
8. Wood Laminating e.g. Plywood Veneering, Formica Bonding, etc.
9. Wood By-Products Plants e.g. Sawdust, Wood Flour, Shaving, Briquets, etc.

FOOD PROCESSING - 10

1. Meat Smoking, Packing, Canning, including Lard Rendering
2. Fish Smoking and Canning (excluding by-products)
3. Bakeries
4. Coffee Roasting
5. Dairy Products Processing including Dried Milk, Condensed Milk, Ice Cream, etc.
6. Grain and Feed Milling, Flour Milling, Cereal Packaging, etc.
7. Fruit and Vegetable Canning and Packaging
8. Beverage Manufacturing
9. Pet Foods, All Types
10. Food Specialty Packaging e.g. Spices, Condiments, Flavorings, etc.
11. Margarine and Oleaginous Products

INEDIBLE ANIMAL AND VEGETABLE BY-PRODUCT PROCESSING - 11

1. Rendering
2. Fertilizer Processing and Packaging
3. Fish Cannery By-Products Processing
4. Tanneries and Hide Processing
5. Wool Processing
6. Dehydrating Food By-Products

HOTELS, APARTMENTS AND OFFICE BUILDINGS (EXCLUDING GOVERNMENTAL) - 12

1. Office Buildings
2. Private Medical Facilities and Private Hospitals e.g. Sanitariums, Hospitals, Clinics, Rest Homes, etc.
3. Private and Religious Schools, Colleges, etc.
4. Motels, Courts and Trailer Parks
5. Apartment Hotels and Apartment Buildings
6. Scientific Research and Development Facilities
7. Scientific Laboratories e.g. Testing, Metallurgical, Bacteriological, etc. (excluding Medical and Dental and Film Processing)

COMMERCIAL ACTIVITIES - 13

1. Retailing Activities, Consumer Sales and Equipment Rentals
2. Wholesalers, Jobbers, Warehouses and Contractors' Yards
3. Electrical and Electronic Repairing, Rebuilding and Servicing
4. Motion Picture and Television Production Facilities
5. Photographic Arts and Processing e.g. Studios (excluding Motion Picture and TV), Film Laboratories, Commercial Artists, Photo Duplicating including Blueprinting and Ozalid
6. Laundries, Rug Cleaning, etc.
7. Cafes, Restaurants and Bars (excluding those in hotels)
8. Printing Shops, Newspapers and Publishers
9. Mortuaries, Crematories and Cemeteries
10. Graphic Arts Specialties and Services e.g. Engravers, Photoengravers, Electrotypers, Mat-makers, Silk Screening, Printed Circuits, etc.
11. Dry Cleaning Plants
12. Junk Yards, Salvaging and Converting of Industrial Materials (excluding Secondary Metal Refining)
13. Business Machines, Sales and Servicing
14. Household Appliances, Sales and Servicing
15. Amusement and Recreational Facilities
16. Agricultural Operations

GOVERNMENTAL AGENCIES AND PUBLIC UTILITIES - 14

1. Public Office Buildings
2. Public Schools, Colleges, Universities, etc.
3. Municipal Incinerators and Disposal Facilities including Sewage Treatment Facilities
4. Publicly and Privately Owned Power Plants Generating Power and/or Steam for Public Use
5. Publicly and Privately Owned Public Utility Facilities e.g. Telephone Co., Gas Co., Waterworks, etc.
6. Governmentally Owned Hospitals
7. Cut and Fill Dumps
8. Transportation Facilities, Terminals, Depots, Stations, etc., for all Transportation Media
9. Governmentally Owned Shipyards

VEHICLE MANUFACTURING AND SERVICING FACILITIES - 15

1. Airframe Production including Guided Missiles
2. Auto and Truck Assembling
3. Trailer Manufacturing and Assembling
4. Aircraft Overhaul Facilities
5. Automotive Component Rebuilding Facilities e.g. Engines, Transmissions, Carburetors, Starters, Generators, Water Pumps, etc.
6. Custom and Special Vehicle Manufacturing (excluding Trucks and Trailers)
7. Auto Wreckers
8. Vehicle Dealers
9. Vehicle Repair Facilities including Vehicle Body Repair Shop
10. Shipyards, Boat Building, Boat Repair, Dry Docks, etc. (excluding Governmentally Owned)
11. Railroad Service and Repair Facilities, Yards, Roundhouses, etc. (excluding Stations, Depots and Warehouses)

TEXTILE, FABRIC, FIBER, MONOFILAMENT MANUFACTURING AND PROCESSING - 16

1. Garment Manufacture
2. Textile and Fabric Coverings Manufacturing e.g. Seat Covers, Tents, Tarpaulins, Draperies, Awnings, etc.
3. Textile and Fabric Processing e.g. Sponging, Shrinking, Waterproofing, Dyeing, Flameproofing, Printing, etc.
4. Mattress, Cushion and Pad Manufacturing and Renovating (excluding Furniture Manufacturing)
5. Paper Products
6. Shoe and Luggage Manufacturing, etc.
7. Brush Manufacturing
8. Special Textiles e.g. Felt, Webbing, Rope, Cordage, Packings, Oakum, Belting, etc.
9. Weaving of Textile Materials e.g. Braid, Tape, Lace, Bindings, Rugs, etc.

is this true in a public nuisance case where it is desirable to *eliminate* from suspicion all equipment which does not contribute to a public nuisance. In such instances, the Equipment List serves as a kind of check list, and may in itself indirectly figure in a court case. The Equipment List should then be formally revised.

On an assigned inventory inspection, the inspector must check all equipment units in the plant against those of the Equipment List. The inspector is careful to note that the equipment listed is not only identical in important respects, but is not a *replacement*, since permit regulations are affected by replacements. This is usually determined by comparing manufacturer's serial numbers. The inspector also checks for new equipment, alteration of equipment, posting of permits, operation contrary to conditions of permit, etc. Any discrepancies noted are recorded in detail on the *Activity Status Report*. (See Figure XIV-9.)

D. Preparation and Maintenance of Equipment Lists for Industrial and Commercial Activities

In the Enforcement Division of the A.P.C.D., the Equipment List is the inventory: it is a list of the equipment units capable of emitting air contaminants contained on the premises of a company located at one address-location. The Equipment List is titled and filed according to the name and address of the company. For example, the "ABC Company", located at "340 Johnson St., Los Angeles 2, California".

A modification of this procedure is made with respect to industrial plants which are in themselves so diversified, and contain so many equipment units that they cannot be inventoried in one continuous inspection. These particularly include plants with elaborate organizational structures, such as an oil refinery, or a large aircraft plant, chemical plants, large steel mills and metal fabricating plants, etc. Such plants are "unitized" for the purpose of establishing Equipment List boundaries. The individual "units" are then scheduled for separate inventory reinspections.

The Enforcement Division refers to the inventory unit or group for which one Equipment List would be made as an *Activity. The Activity is defined* as an *industrial plant or a commercial enterprise occupying one address-location, or a unit of production capable of standing alone as an independent source activity in the industrial economy, but which is integrated into a large industrial plant at one address-location.* The latter represents unitization. Unitization, however, is always dictated by necessity. It is preferable, wherever possible, to maintain a complete inventory record of one address-location. The basis of record-keeping and classification should attempt to remain as consistent as possible with the legal entity — the company-address-location which would be involved in a legal proceeding.

The Source Activities are classified in the A.P.C.D. by means of a Primary and a Secondary Activity Classification System (see Table XIV-1). The *Primary Activity Classification* breaks the industrial economy of the pollution zone down into some sixteen general technological or commercial activities grouped according to similar air pollution potentials. The purpose of such a classification system, ultimately, is to disclose those source activities within each of these technological categories which have air pollution potentials, and those which do not, or have little. With such a classification system a complete *area inventory* can be approached.

Each primary activity is composed of the secondary "source activities" which would be found at individual address-locations. For example, the "Metal Melting and Reclaiming Activity", a primary activity classification, is coded as "05", while the secondary Source Activities comprising the classification are as follows:

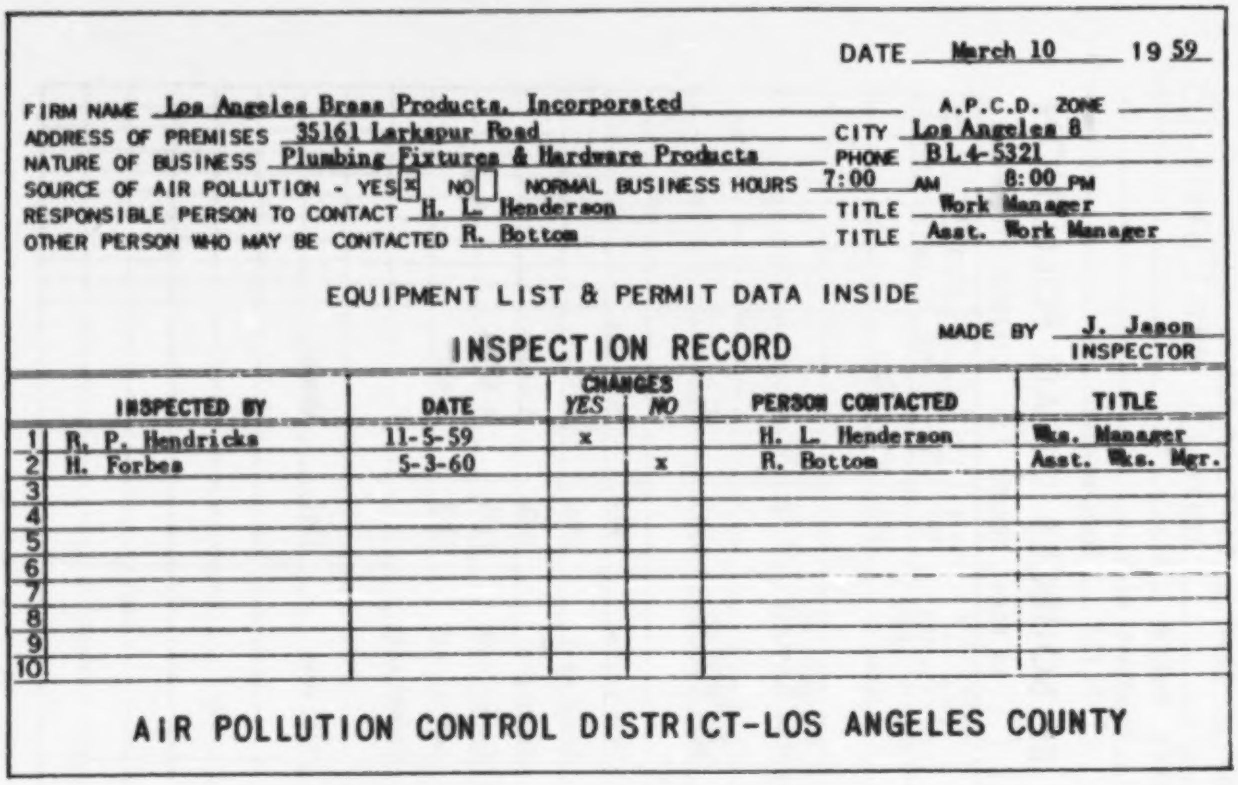
1. Gray Iron Foundry Facilities
2. Steel Foundry Facilities
3. Brass (Red and Yellow) Foundry Facilities
4. Aluminum Foundry Facilities
5. Magnesium Foundry Facilities
6. Miscellaneous Non-ferrous Foundry Facilities and Die Cast
7. Secondary Refiners
8. Core Making Facilities

The Brass Foundry Facility (05-3), for example, is a Source Activity, whether it is a complete self-contained plant or an independent commercial activity, as it is usually found, or a department within a large industrial plant, such as a large plumbing products manufacturing plant. In the example of a large plumbing products plant, additional source activities may be found such as a plating department or a machine shop coded as separate source activities under other Primary and Secondary Activity Classifications.

We can see from this system that if an industrial unit within a plant at one address-location can be conveniently classified and given a primary and secondary classification code number which differs from those which may be assigned to the remaining departments or units within the plant, a separate Equipment List is made. In order to locate all the source activities with different classifications which may be found at one address-location, a visible reference cross-indexed file is used to recombine these source activities alphabetically.

1. The Manila Envelope and Field Inventory File

The inspector completes the Equipment List in duplicate. The original is brought to Headquarters for review and filing. The duplicate, the inspector's field copy, is maintained inside of a Manila File Envelope. (See Figure XIV-1.) This envelope is designed to contain the Equipment List, duplicates of permits issued, variances, records of court cases, office and field hearings, photographs and any other documents of use in the field. It is maintained in a sector file in the inspector's vehicle, and is filed either alphabetically by name of company, or by street and number.



DATE March 10 19 59

FIRM NAME Los Angeles Brass Products, Incorporated A.P.C.D. ZONE
ADDRESS OF PREMISES 35161 Larkspur Road CITY Los Angeles 8
NATURE OF BUSINESS Plumbing Fixtures & Hardware Products PHONE BL4-5321
SOURCE OF AIR POLLUTION - YES ☒ NO ☐ NORMAL BUSINESS HOURS 7:00 AM 8:00 PM
RESPONSIBLE PERSON TO CONTACT H. L. Henderson TITLE Work Manager
OTHER PERSON WHO MAY BE CONTACTED R. Bottom TITLE Asst. Work Manager

EQUIPMENT LIST & PERMIT DATA INSIDE

INSPECTION RECORD

MADE BY J. Jason
INSPECTOR

	INSPECTED BY	DATE	CHANGES YES	CHANGES NO	PERSON CONTACTED	TITLE
1	R. P. Hendricks	11-5-59	x		H. L. Henderson	Wks. Manager
2	H. Forbes	5-3-60		x	R. Bottom	Asst. Wks. Mgr.
3						
4						
5						
6						
7						
8						
9						
10						

AIR POLLUTION CONTROL DISTRICT-LOS ANGELES COUNTY

Figure XIV - 1. Manila envelope field inventory file.

The face of the Manila envelope provides the inspector with preliminary data he can check at a glance, such as ownership, address and nature of the business.

The Manila envelope is made for each business location only when sources of air pollution are present on the premises.

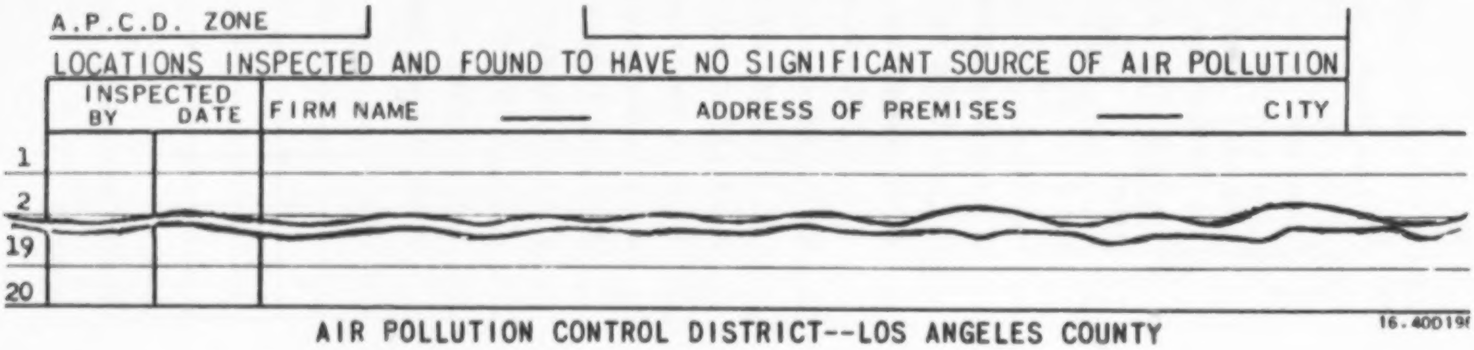
On the face of the envelope, the entire heading involving plant data is completed in full. All blanks are answered either positively or negatively.

In preparing the envelope, the inspector places his signature and date of preparation in the space provided immediately to the right of the words "Inspection Record".

The information requested on the bottom half of the envelope pertains to reinspections only. The first line is for the use of the sector inspector reinspecting the location. After completing the inspection, the inspector enters on this line his name and the date. He checks "Yes" or "No" if changes involving the equipment list are noticed, and enters the name and title of the person contacted.

2. When Equipment Lists Are Made

Both the Equipment List and Manila Envelope are prepared by the inspector for an activity, only if there are sources of air pollution on the premises. If there are no sources of air pollution, the Equipment List and Manila Envelope are not prepared. The "non-source" activity, however, is still accounted for in two ways. First, the inspector reports on an *Activity Status Report* the name and location of the company, the nature of the business, etc., and the expansion potential of the company, or some indication as to the likelihood of the establishment to install equipment capable of air pollution in the future: such indication is important for scheduling a reinspection. If the plant is



A.P.C.D. ZONE

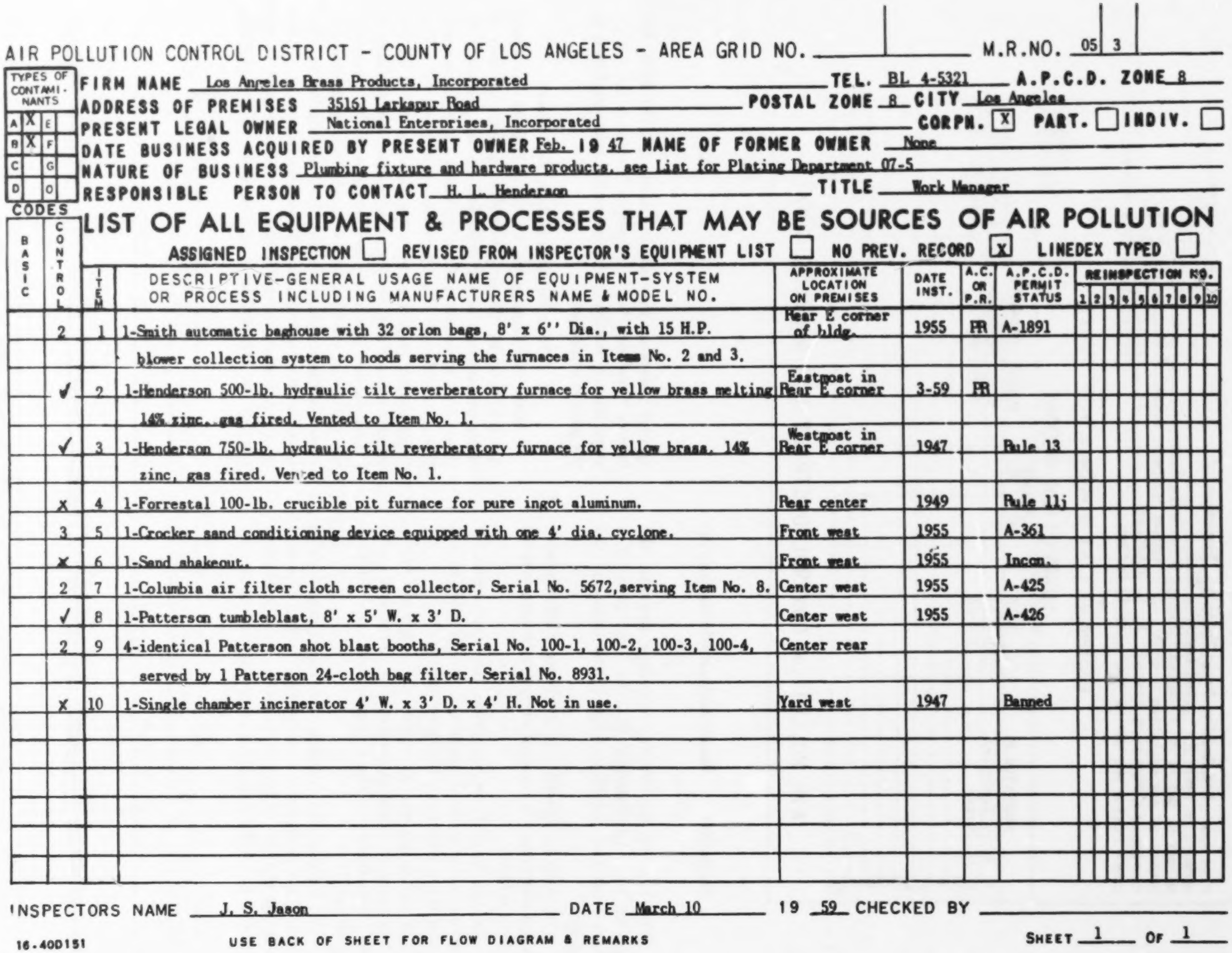
LOCATIONS INSPECTED AND FOUND TO HAVE NO SIGNIFICANT SOURCE OF AIR POLLUTION

	INSPECTED BY	INSPECTED DATE	FIRM NAME	ADDRESS OF PREMISES	CITY
1					
2					
19					
20					

AIR POLLUTION CONTROL DISTRICT--LOS ANGELES COUNTY

16.40019

Figure XIV - 2. Non-source inventory card.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES - AREA GRID NO. ______ M.R.NO. 05 3

TYPES OF CONTAMINANTS	
A X	E
B X	F
C	G
D	O

FIRM NAME Los Angeles Brass Products, Incorporated TEL. BL 4-5321 A.P.C.D. ZONE 8

ADDRESS OF PREMISES 35161 Larkspur Road POSTAL ZONE 8 CITY Los Angeles

PRESENT LEGAL OWNER National Enterprises, Incorporated CORPN. ☒ PART. ☐ INDIV. ☐

DATE BUSINESS ACQUIRED BY PRESENT OWNER Feb. 19 47 NAME OF FORMER OWNER None

NATURE OF BUSINESS Plumbing fixture and hardware products, see List for Plating Department 07-5

RESPONSIBLE PERSON TO CONTACT H. L. Henderson TITLE Work Manager

LIST OF ALL EQUIPMENT & PROCESSES THAT MAY BE SOURCES OF AIR POLLUTION

ASSIGNED INSPECTION ☐ REVISED FROM INSPECTOR'S EQUIPMENT LIST ☐ NO PREV. RECORD ☒ LINEDEX TYPED ☐

CODES BASIC	CODES CONTROL	ITEM	DESCRIPTIVE-GENERAL USAGE NAME OF EQUIPMENT-SYSTEM OR PROCESS INCLUDING MANUFACTURERS NAME & MODEL NO.	APPROXIMATE LOCATION ON PREMISES	DATE INST.	A.C. OR P.R.	A.P.C.D. PERMIT STATUS	REINSPECTION NO. 1	2	3	4	5	6	7	8	9	10
	2	1	1-Smith automatic baghouse with 32 orlon bags, 8' x 6'' Dia., with 15 H.P.	Rear E corner of bldg.	1955	PR	A-1891										
			blower collection system to hoods serving the furnaces in Items No. 2 and 3.														
	✓	2	1-Henderson 500-lb. hydraulic tilt reverberatory furnace for yellow brass melting	Eastmost in Rear E corner	3-59	PR											
			14% zinc, gas fired. Vented to Item No. 1.														
	✓	3	1-Henderson 750-lb. hydraulic tilt reverberatory furnace for yellow brass. 14%	Westmost in Rear E corner	1947		Rule 13										
			zinc, gas fired. Vented to Item No. 1.														
	X	4	1-Forrestal 100-lb. crucible pit furnace for pure ingot aluminum.	Rear center	1949		Rule 11j										
	3	5	1-Crocker sand conditioning device equipped with one 4' dia. cyclone.	Front west	1955		A-361										
	X	6	1-Sand shakeout.	Front west	1955		Incon.										
	2	7	1-Columbia air filter cloth screen collector, Serial No. 5672, serving Item No. 8.	Center west	1955		A-425										
	✓	8	1-Patterson tumbleblast, 8' x 5' W. x 3' D.	Center west	1955		A-426										
	2	9	4-identical Patterson shot blast booths, Serial No. 100-1, 100-2, 100-3, 100-4,	Center rear													
			served by 1 Patterson 24-cloth bag filter, Serial No. 8931.														
	X	10	1-Single chamber incinerator 4' W. x 3' D. x 4' H. Not in use.	Yard west	1947		Banned										

INSPECTORS NAME J. S. Jason DATE March 10 19 59 CHECKED BY ______

16-40D151 USE BACK OF SHEET FOR FLOW DIAGRAM & REMARKS SHEET 1 OF 1

Figure XIV-3. Equipment list used for inventorying the sources of pollution at an industrial activity.

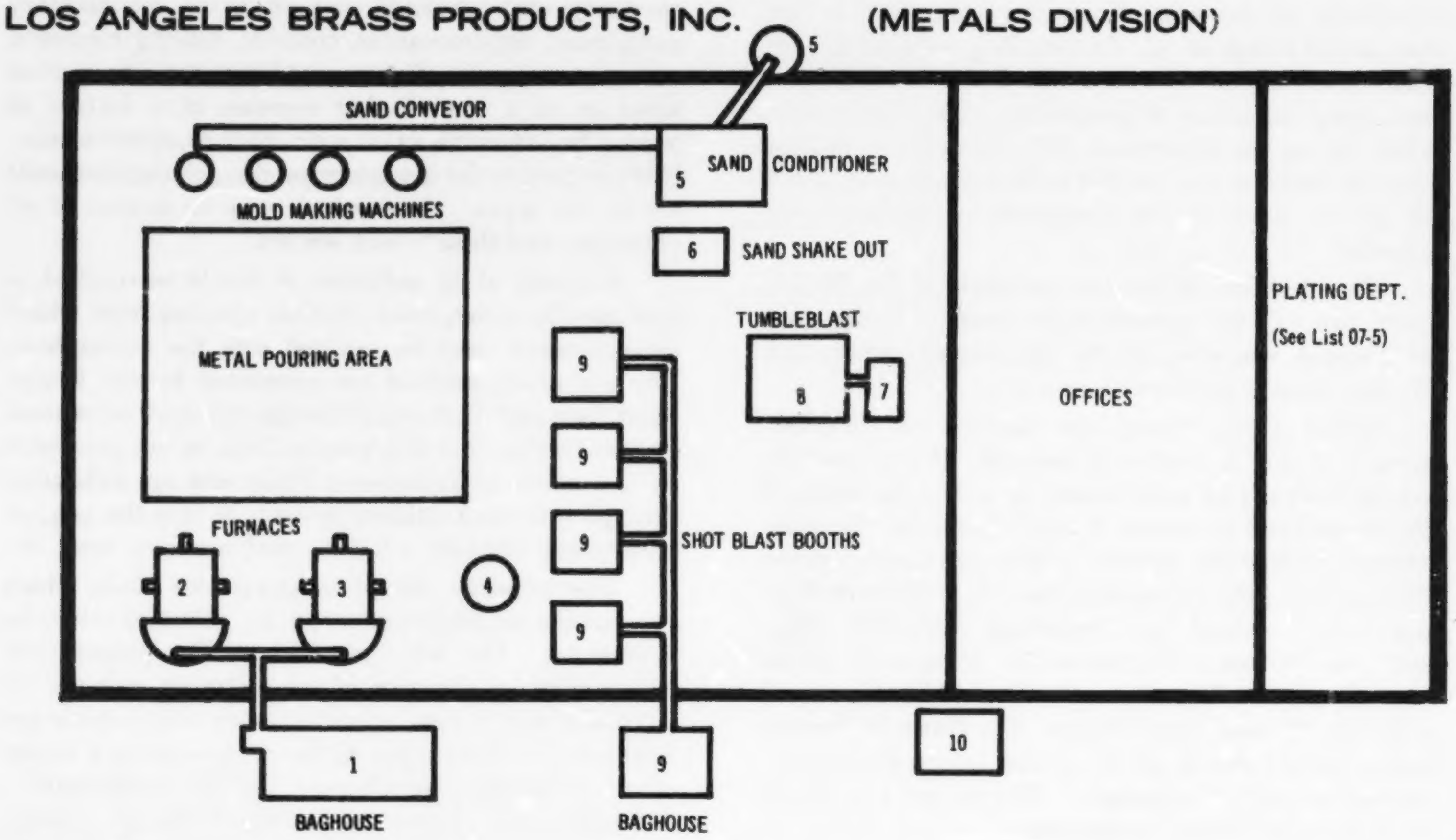


Figure XIV - 3.1. Plot plan on reverse of Equipment List to illustrate positioning of equipment.

a type of activity such as a warehouse in which no sources of air pollution can be expected to be added to the premises, it should be scheduled for reinspection on a frequency "0" basis. If, on the other hand, the plant is a small plating shop with a few plating tanks but a great deal of unoccupied floor space, that plant might expand its manufacturing operation to include other tanks or operations subject to A.P.C.D. permit requirements, and should be inspected at least once each year. Second, the inspector lists the company on a Non-Source card. The *Activity Status Report* is forwarded to Headquarters and is filed in the Equipment Inventory Dossier File (see Chapter 6). The Non-Source card remains with the inspector's Field Inventory File.

If the Source Activity has equipment which is a significant source of air pollution, both a Manila Envelope and an Equipment List are made out for the *initial inspection*. The Equipment List is made out in duplicate, the original is sent to Headquarters and the duplicate is filed by the inspector in the Manila File Envelope.

On the inventory reinspection, the inspector revises or confirms the correctness of the existing Equipment List. The list is revised to incorporate any changes which have taken place since the last visit. If the revision is extensive, a new Equipment List in duplicate is prepared. If the change is minor, an *Activity Status Report* need only be made to account for the change. The status report is always made in duplicate, like the Equipment List. The original is sent to Headquarters, and the copy is maintained in the Manila Envelope File.

An exception to this procedure is made in the case of inspections of refineries and petrochemical plants. Such inspections are made according to *process* rather than *equipment units*, and are inventoried in a somewhat different manner, as will be described later.

3. Preparing the Equipment List

The Equipment List is broken down into four basic parts: (1) business and ownership data of the source activity; (2) description and location of each piece of equipment, (3) Permit Status of each equipment unit, and (4) coded equipment data. For convenience the Equipment List in Figure XIV-3 should be referred to. This discussion is concerned with making an Equipment List on an initial inspection.

a. Business and Ownership Data of the Source Activity

All business and ownership data are contained on the heading of the Equipment List. The heading is usually filled out during the initial interview with plant management, in order to gather the background data necessary for the determination of the permit status of each piece of equipment to be inspected. The procedures for identifying the company, its type of ownership, its owners, officers or managers, are the same as described in "C. Persons Responsible for Violation", in Chapter Thirteen. Here also the inspector seeks legal definition of ownership. The information called for on the Equipment List, however, is broken down in detail so that all of the data which may affect the permit status of the equipment in the plant are included.

The elements of the data pertinent to the Permit Status are (1) the present legal owner, (2) the date the business was acquired by the present owner, and (3) the name of the former owner.

Under Firm Name, the business or fictitious name — if one is used — is entered. If the business uses the owner's personal name, then only the name of the owner (and co-owner, if any) is entered. In cases where a corporation operates a business under a name different from the corporate name, i.e., "Western Furniture Co.", owned by "American Furniture Mfg., Inc.", the "Western Furniture Co." is recorded under Firm Name and "American Furniture Mfg. Co., Inc." under the Present Legal Owner. The Name of Former Owner should also be given. If this information is unobtainable, state: "unknown". If new construction is involved write "New" in this space.

On the line entitled "Nature of Business" an inclusive description of the general purposes and processes of the enterprise and the products produced should be recorded. The terminology listed in the Primary Activity Classification such as "office building", "brass foundry facilities", "plating facility", etc., should be included. A more detailed explanation of the nature and size of the business can be given on the reverse of the Equipment List such as:

(1) End product manufactured, processed or produced.
(2) Raw materials used.
(3) Approximate size of plant in terms of production volume, men employed, sq. ft. of plant area, etc.
(4) Number of shifts worked and normal working hours of plant.
(5) Flow sheets for process plants.

Where several primary activities are carried on in the same premises, separate Equipment Lists are made to cover each Source Activity of substantial magnitude. Note on the Equipment List (Figure XIV-3) the reference to the plating department under "Nature of Business".

b. Description and Location of Each Equipment Unit

The main purpose of the inventory is to list, itemize and to identify by description each piece of equipment in the source activity. For our purposes here we shall call this "piece" or "item" of equipment an *Equipment Unit*, which may be defined as follows:

An *Equipment Unit* is an identifiable piece of equipment which operates as a complete functioning unit either as a solitary piece of equipment or as a cluster of related equipment, *consisting* of a primary operating unit *equipped with* or *served* by auxiliary equipment, appurtenances, controls, heating elements, or equipment parts. Equipment Units can either stand alone or as a contributing member of a *battery* or *process* by interconnection with other equipment units. With respect to the inventory process, equipment units are of two types. Those which *may* be sources of air pollution, and those which are not.

A source of air pollution, it should be recalled, is that specific outlet, stack or other opening from which air pollutants may be emitted into the atmosphere. The pollutants emitted are generated by the Equipment Unit and discharged through the stack or exhaust system serving that Equipment Unit, or are generated by a number of Equipment Units and are exhausted through one stack effluent system, or into the general atmosphere through a louvre, roof monitor, vent, etc.

The inspector identifies Equipment Units which are *capable* of being sources of air pollution when he inventories. The description of an Equipment Unit which may be a source of air pollution includes all auxiliary equipment, appurtenances, etc., which are relevant to a description of the *equipment as a source of air pollution*. (See Chapter 13, "D. Equipment".) All equipment appurtenances which are of a minor character, or are irrelevant to characterizing the Equipment Unit as a source of air pollution are omitted from the cluster description. The ability to describe equipment reflects an understanding of the variables affecting the air pollution potential of the Equipment Unit.

For example, Figure XIV-4 below gives a complete schematic of an oil-fired boiler.

Among many components of equipment which might be noted are those shown below:

> firebox, oil lines, Pierson rotary type oil-burner, electric pre heater, fan housing, pressure gauges, oil strainer, thermostat, automatic controls on burner, damper, fire-tube section, name given as Rodney Iron Works boiler, rated at 250 H.P., Serial No. 12345, etc.

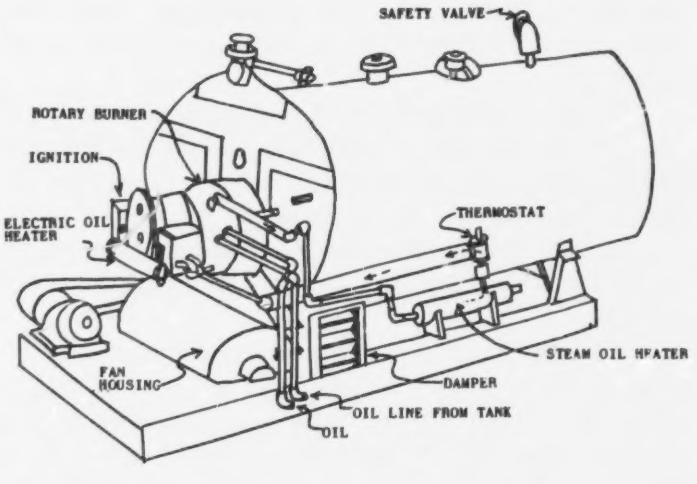


Figure XIV - 4. Simplified drawing of a fire-tube boiler and essential accessories. Suggested inspection points: oil heaters, dampers, fan housing, ignition mechanism, fire box and rotary cup oil burner.

From such details this boiler could be described in many of several ways. All that is required are those significant facts and items which clearly identify the equipment unit and describe something of its character as a source of air pollution. For example, the boiler could be described as:

> 1—250 H.P. Fire-Tube, Rodney Iron Works, Boiler, Serial No. 12345, equipped with one automatic Pierson Rotary Cup Oil Burner, Serial No. 3526, and one electric 95°F. oil preheater.

Other equipment, gauges, thermostats, etc., are obviously not significant in the description. Also, it is unnecessary to include devices or portions of devices which may always be found with the class of equipment. For this reason, the firebox, fan housing, oil strainer, oil lines (since we know this an an oil-fired boiler) and even the stack need not be mentioned, though on occasion the height and diameter of the stack is given, especially when two or more boilers are breeched to a common stack. Here we may note, that the terms "equipped with", "served by", or "consisting of" are the key words found in most cluster descriptions.

(1) Basic Equipment and Control Equipment

Equipment Units capable of air pollution, in turn, fall into two classes.

> *Basic Equipment*: This class includes any articles, machine, equipment, or other contrivance, the use of which may cause the issuance of air contaminants.
> *Air Pollution Control Equipment*: This class includes any article, machine, equipment, or other contrivance, the use of which may eliminate or reduce or control the issuance of air contaminants.

Figure XIV-5 diagrams a control system for two brass furnaces of the reverberatory rotary type.

Each reverberatory furnace is a basic unit of Equipment, equipped with shell, refractory, rotary and tilting devices, and oil or gas burners. Thus, there are two basic equipment units in battery.

The control unit consists of the entire collection system: hoods, cooling ducts, motor and fan, baghouse, and hopper. A description of the control unit includes the number of bags, the material used, the size, whether the baghouse is automatically or manually rapped, the blower horsepower, and type of precooling system. (In this case, radiational.) In this example, *one* unit of collection equipment serves *two* units of basic equipment.

Under the Rules and Regulations, basic and control equipment require separate permits, and are usually itemized separately on the Equipment List.

(2) Permit Unit and Equipment Unit

In order to establish criteria governing the submission of applications for permits under the permit system, the Engineering Division of the A.P.C.D. has established a "permit unit". A permit unit is that basic or control equipment, or grouping of such equipment, for which one application would be made and, upon approval of the application, one permit would be issued. It is defined as a "functionally whole article or machine or equipment or contrivance as a group. The functional whole is determined on the basis of either (1) a specific pollution problem, or (2) the association of individually identifiable items of equipment to accomplish a process or manufacture. A Permit Unit may consist of one individual item or a group

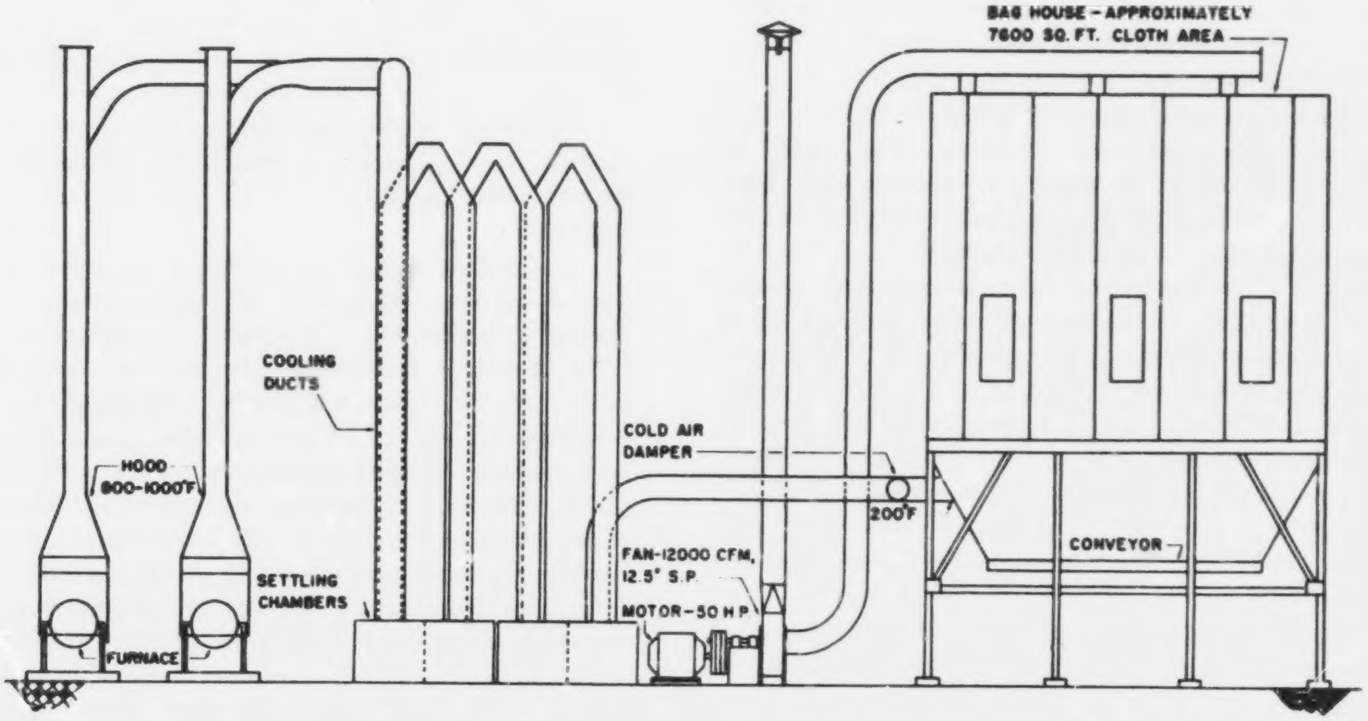


Figure XIV-5. Diagram of basic and control equipment for two brass furnaces served by cooling columns and cloth filtering system.

of two or more items."* Generally, the permit unit applies to all equipment which *must* operate together to perform a specific function. In most instances final approval as to the organization of the permit unit must be made by a member of the Engineering Division, rather than the Enforcement Division.

Permit and Equipment Units may frequently be identical, i.e., refer to the same grouping, cluster or piece of equipment, particularly when the equipment unit is "functionally whole determined on the basis . . . of (1) a specific pollution problem". A single boiler, for example, not part of a process, is a Basic Equipment Unit as well as a Permit Unit, and is listed as a separate item on the Equipment List. A gray iron cupola in a foundry is another Basic Equipment Unit, as well as a Permit Unit. The entire control system serving the cupola, including the evaporative cooler, duct, blowers, fan and motor and cloth filtering unit is considered as a separate equipment unit as well as a separate permit unit. The inspector has the option of listing equipment according to Permit Units or separate Equipment Units which might be contained in one permit unit, according to which makes the clearest reference for enforcement purposes.

Both types of units, then, are a matter of convenience to the person who must decide how to group equipment, the inspector in the case of the inventory, and the engineer in the case of the permit. The definition of the equipment unit is amenable to delineations of reference for purposes of enforcement whereas the permit unit is a guide in making decisions with respect to how equipment shall be grouped on permit applications. The permit unit is more of a criterion for unusual cases than it is for typical cases where such grouping is logically dictated in both systems. In the case of the permit unit, the engineer must also consider electric motor horsepower, heating values, and other factors that affect the permit fee.

Several circumstances in which it is convenient for enforcement purposes to break what would be Permit Units down into smaller Equipment Units may occur. One of these covers such circumstances in which any change in any one of the equipment units is tantamount to alteration of the entire permit unit, requiring reapplication for equipment under Rule 10. It is thus desirable to make a strict accounting of all equipment components which may affect the permit status within the Permit Unit. Especially is this true in the case where Part 2 of the Permit Unit definition, "the association of individually identifiable items of equipment to accomplish process or manufacture," applies. Here for "Items of Equipment" read "Equipment Units".

Also, in complex cases only the Engineering Division is capable of making formal definitions of "permit units" on the basis of policy and previous experience. It is safer, then, for the inspector to list equipment units when he is in doubt.

The difference between the Permit Unit and the Equipment Unit is thus a matter of form. It is a question of whether such equipment should be described as a cluster unit as one itemization, or whether that cluster should be broken down into individual items on the Equipment List. If they are broken down on the Equipment List, they must be listed consecutively so that the same "A.P.C.D. Permit Status" can apply to the units comprising the permit unit.

(3) Itemization of Equipment Units.

The itemization of equipment units on the Equipment List comprises the actual inventory or accounting process. The Item Column may be noted in the left-hand column of the Equipment List in Figure XIV-3. Equipment units are itemized in normal consecutive counting order, that is "1", "2", "3", "4", "5", etc. Only those equipment units, the use of which may cause the emission or reduction of air contaminants, are itemized. All equipment which may be sources of air pollution but exempt by Rule 11 or otherwise administratively exempt are also listed. Equipment units which are clearly *non-sources*, including those specifically exempted by Rule 11, are not itemized. Equipment which emits very small amounts of air pollution is listed, but is noted as "inconsequential" (see Item #6 on Figure XIV-3).

The inspector has considerable latitude in itemizing equipment to fit the groupings which he encounters, and the relative importance of each piece of equipment. An important piece of equipment may be handled as a separate itemization and with considerably more detail than one which is of little consequence. Generally, the inspector's description of his itemization is based on one of the following equipment groupings: (1) individual equipment units, (2) more than one, but exactly identical equipment units, (3) control-basic equipment combinations, (4) equipment battery combinations, and (5) process unit combinations.

Individual equipment units are described according to their mechanical or chemical function as "boiler", "incinerator", "furnace", "spray booth", etc. In a detailed description all auxiliary equipment parts with which the equipment is equipped or which it serves or is served by are included. Such auxiliary equipment as burners, motors, etc., are described with the equipment unit if they are essential. They are never itemized separately. Most industrial situations outside of refinery and chemical plants are made up of individual equipment units, and most Equipment Lists are made along the lines of those of the brass foundry shown in Figure XIV-3. Equipment units are still considered to be individual units even when a product moves from equipment to equipment on a moving belt or chain-type conveyor. Process units pneumatically connected are treated differently, however.

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* A.P.C.D. Engineering Division, *Administration of the Permit System*, December 1958, Page 10.

Exactly *identical* equipment units may be grouped together as long as the equipment is identical as to structure and use and the exact number of equipment units is given (see Item 9, Figure XIV-3).

Although control and basic equipment in combination are generally itemized separately, it is sometimes economical to make a single listing of relatively minor equipment. A good rule is to consider whether or not they comprise an original combination, that is, a mixture of equipment types or makes, etc., or whether they form a manufacturer's "package unit". The air pollution potentials of the individual equipment units are also taken into account. For example, Item 9 is itemized together as a package unit by one manufacturer, even though five equipment units are involved. On the other hand, the inspector chose to separate Items 7 and 8 because of the relatively unique combination of equipment normally found in separate "package units".

Items 1, 2 and 3 cannot be combined into one listing under any circumstances, however, because of (1) the relatively high air pollution potentials of the individual equipment units as indicated by their capacities and the character of the melt, (2) the uniqueness of such equipment in the combination, and (3) the variations in the permit status of the individual equipment units.

The *battery* or *series* of equipment units refers to a group of similar (but not always) individual equipment units not contributing to a process, but exhausting through one system. For example, a power plant may consist of 5 boilers in battery exhausting through one exhaust system or stack. A plating plant may have several plating tanks in series which exhaust through one blower or control system.

Equipment units involved are generally listed separately, particularly when they are large or important pieces of equipment. In such instances the same rules apply to the battery as to identical or combined units. Note that Items 2 and 3 in Figure 3 actually constitute a battery. Item 9 is also a battery consisting of identical pieces of basic equipment. Since the equipment is identical, one listing can be made. Whenever a battery situation is involved, each itemization should note its connection to the common exhaust system by referring to the proper Item number. (Note again, Items 2 and 3.)*

The *Process Unit* may be defined as a group of equipment or process vessels which are interconnected by sealed or ducted flow systems, such as might be found in a refinery or petrochemical plant. (See Figure XIV-10.) The product moving through the unit is progressively transformed towards a desired end point in the individual equipment in the system. All of the equipment in the process may exhaust into one local exhaust or control system. That is, a gas or vapor gathering system for the entire unit may exhaust either to a control device or into the general atmosphere. The basis for considering the process is made in terms of one specific pollution problem, or in terms of those identifiable items of equipment necessary to accomplish a process or manufacture.

In itemizing the process unit, the inspector also has a choice. He may either list each piece of equipment in the process as a separate item, or he may list the entire process as one item, including in the description a list of the individual equipment units making up the process. (An entire process unit can be listed as one item as long as it does not involve more than one permit unit.) Whichever he does, the inspector must indicate in some way the relationship of the equipment in the process. Generally, the key words are "....................process (or system) consisting of the following: .... etc." Sometimes this grouping may also be accomplished by bracketing all of the items or units of equipment. The more complex the process, the more the description will require support and clarification from an attached flow chart.

(a) Order of Equipment Listing

When breaking equipment combinations down for listing, it is best to list the control equipment first, then the basic equipment in a consecutive or logical order, and to cross-reference the item numbers as in Items 1 through 3 on Figure XIV-3 of the Equipment List. The order of listing is guided by the logic of the most prominent situation encountered, i.e., by production sequence, relative floor position or plant location number, order of size or capacity, etc.

(4) Location of Equipment, Plant Layout and Flow Charts

The location of the equipment should be indicated under the "Approximate Location on Premises" column of the Equipment List. The approximate location can be merely designated according to the position of equipment relative to the front of the plant and the direction north, i.e., as it would appear on a plot plan. Designations may be made as follows: "Rear", "Front", and "Rear-west", etc. In large complex plants with many kinds of sources of air pollution, these descriptions may not be sufficient. An equipment location drawing (plot plan) should be prepared on the cross-hatch backing of the Equipment List (see Figure XIV-3.1. The plot plan should show clearly the general outline of the plant floor, the intersecting streets around the plant, the departmental organization, and the location of each specific piece of basic and control equipment. Where the industrial plant has multiple stories and the equipment is interconnected by means of blower and duct systems, each floor plan should be shown.

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* However, equipment in battery, such as abrasive blast booths, may individually constitute separate Permit Units.

In the case of complicated process units, a flow chart showing the flow of materials through a production sequence should be prepared for clarification. In general, both the process flow drawings and the plant layout are carefully drawn sketches, rather than accurately scaled mechanical engineering drawings. These drawings are included to supplement the data on the front side of the Equipment List, and should be sufficient to identify equipment for inventory purposes and to indicate the type of contaminants emitted and the possible air pollution potentials.

Flow diagrams and plot plans are of particular importance in accounting for all equipment in a production sequence which otherwise may be overlooked. They are of value in showing the potentiality of an existing production system for growth or change as a result of addition, change or replacement of individual equipment units. They also show the capacity for such systems to accommodate increased production quotas. Comparison of existing conditions at the time of an inventory reinspection with the flow chart and plot plans made on a previous inventory inspection shows exactly how the process was changed.

Also, the process or box-flow system is important in providing inspectors and all other personnel who may examine the Equipment List with important information regarding the industry in question. Inventory records serve as a cumulative file of technical information. For example, the inspector conducting the initial inspection gathers basic facts and information about the process. The next inspector, by studying the Equipment List, is armed with important information, enabling him to gather further information and to augment the Inventory Dossier File.

A more detailed description of process flow procedures is described in the Refinery and Petrochemical Inventory in this chapter. (See Figure XIV-10.)

c. Permit Status of Each Equipment Unit

The Permit Status is the status of equipment made with respect to compliance with the permit sections of the entire A.P.C.D. authority. The essentials of this authority in the State Health and Safety Code are quoted here in part.

> 24263. (Amended—effective 9-11-57.) The Air Pollution Control Board may require by regulation that before any person either builds, erects, alters, replaces, operates, sells, rents, or uses any article, machine, equipment, or other contrivance specified by such regulation the use of which may cause the issuance of air contaminants, such person shall obtain a permit to do so from the Air Pollution Control Officer.
>
> Insofar as the regulations do not grant an automatic permit for the operation or use of any article, machine, equipment or contrivance in existence upon the effective date of such regulations, a permit shall not be required without first affording the owner, operator, or user thereof a reasonable time within which to apply for such permit, and to furnish the Air Pollution Control Officer the information required pursuant to Section 24269.
>
> 24269. The air pollution control officer at any time may require from an applicant for, or holder of any permit provided for by the regulations of the air pollution control board, such information, analyses, plans, or specifications as will disclose the nature, extent, quantity, or degree of air contaminants which are or may be discharged by such source.
>
> 24264. The air pollution control board may require that before the air pollution control officer issues a permit to build, erect, alter, or replace any equipment, that the plans and specifications show, and that the permit issued by the air pollution control officer require, that such building, erection, alteration, or replacement will be done in such a manner, and that such approved equipment be used as the air pollution control board finds will eliminate or reduce the discharge of any air contaminants.

(1) When Permits Are Required

The Rules and Regulations were first approved on February 1, 1948, and have since been periodically amended. Rules 10 through 13 which follow should be studied carefully by the inspector as they are basic to any action he will take in the field.

> Rule 10 (Amended 12-4-58) PERMITS REQUIRED. a. Authority to Construct. (Amended 12-4-58) Any person building, erecting, altering or replacing on or after February 1, 1948, any article, machine, equipment or other contrivance, the use of which may cause the issuance of air contaminants or the use of which may eliminate or reduce or control the issuance of air contaminants, shall first obtain authorization for such construction from the Air Pollution Control Officer. An authority to construct shall remain in effect until the permit to operate the equipment for which the application was filed is granted or denied or the application is canceled.
>
> b. Permit to Operate. (Amended 11-16-54.) Before any article, machine, equipment or other contrivance described in Rule 10(a) may be operated or used, a written permit shall be obtained from the Air Pollution Control Officer. No permit to operate or use shall be granted either by the Air Pollution Control Officer or the Hearing Board for any article, machine, equipment or contrivance described in Rule 10(a), constructed or installed without authorization as required by Rule 10(a), until the information required is presented to the Air Pollution Control Officer and such article, machine, equipment or contrivance is altered, if necessary, and made to conform to the standards set forth in Rule 20 and elsewhere in these Rules and Regulations.

Subparagraph "c" of Rule 10 requires that permits be displayed adjacent to operating equipment, while "d" prohibits alteration or counterfeiting of permits. Subparagraph "f" of this Rule requires a permit to sell or rent incinerators.

Permits are not transferable,according to Rule 12.

> RULE 12.(Amended 1-16-58) TRANSFER. An authority to construct, permit to operate or permit to sell or rent shall not be transferable, whether by operation of law or otherwise, whether from one location to another, from one piece of equipment to another, or from one person to another.

All equipment owned and operated prior to February 1, 1948, has blanket permits. This is sometimes known as the "Grandfather Clause".

> RULE 13. BLANKET PERMITS. Every person who, at any time between December 1, 1947, and the effective date of Rule 10, operated or used any article, machine, equipment, or other contrivance for the operation and use of which these rules require a permit, and so operated or used such article, machine, equipment or other contrivance in compliance with all laws, statutes, and ordinances applicable thereto, is hereby by these rules granted a permit to continue or resume such operation or use.

Thus all equipment capable of emitting air contaminants, or capable of reducing or controlling air contaminants, constructed after February 1, 1948, requires an Authority to Construct and a Permit to Operate from the Air Pollution Control District. All equipment constructed and operated prior to that date is automatically granted a permit. Air contaminants are defined by Section 24208 of the Health and Safety Code as smoke, charred paper, dust, soot, grime, carbon, noxious acids, fumes, gases, odors, particulate matter or other air contaminants.

(2) Exceptions to the Permit Requirements

In determining permit status, the inspector should ascertain whether the equipment in question is legally excepted by any provisions of the State Health and Safety Code or the Rules and Regulations of the Air Pollution Control District, or is exempt under current Administrative Directive.

The legal exceptions applied to the permit requirements are contained in State Code Sections 24251, 24254, 24265 and District Rules 11 and 13.

Although District Rule 11 and State Code Section 24265 were essentially identical for enforcement purposes prior to March 28, 1957, the exceptions contained in Section 24265 were not included in Rule 11 until November 16, 1954. On March 28, 1957, Rule 11 was amended to include additional exemptions. Both Sections 24265 and Rule 11 are quoted here for comprehensiveness.

> SECTION 24254—Although permits are required from governmental agencies, this section states that there is no liability for their officers or employees for failure to apply for permits to operate, nor for violations. Civil actions, however, can be brought against governmental agencies in the name of the people of the State of California to force compliance with permit requirements.
>
> 24265. A permit shall not be required for:
>
> (a) (Amended—effective 9-11-57.) Any vehicle as defined in the Vehicle Code.
>
> (b) Any structure designed for and used exclusively as a dwelling for not more than four families.
>
> (c) An incinerator used exclusively in connection with such a structure.
>
> (d) (Amended—effective 9-11-57.) Barbecue equipment which is not used for commercial purposes.
>
> (e) (Amended—effective 9-11-57.) Equipment described in Section 24251; except that the Air Pollution Control Board of any county, any part of which lies south of the Sixth Standard Parallel South, Mount Diablo Base and Meridian, may at its discretion require operations described in Section 24251 (b) to obtain permits. The board may promulgate such rules and regulations, as herein provided for, but in no event shall a permit be denied an operator, operating orchard or citrus grove heaters, if such heaters produce unconsumed solid carbonaceous matter at the rate of one (1) gram per minute, or less.
>
> (f) Repairs or maintenance not involving structural changes to any equipment for which a permit has been granted.
>
> As used in this section, maintenance does not include operation.
>
> (Effective 9-11-57.) This section does not limit the powers granted to the Air Pollution Control Board by Section 24260 and Section 24262 of this code.
>
> RULE 11. (Amended 12-4-58) EXEMPTIONS. An authority to construct or a permit to operate shall not be required for:
>
> a. Vehicles as defined by the Vehicle Code of the State of California.
>
> b. Vehicles used to transport passengers or freight.
>
> c. Equipment utilized exclusively in connection with any structure, which structure is designed for and used exclusively as a dwelling for not more than four families.
>
> d. The following equipment:
>
> 1. Comfort air conditioning or comfort ventilating systems which are not designed to remove air contaminants generated by or released from specific units of equipment.
> 2. Cold storage refrigeration equipment.
> 3. Internal combustion engines.
> 4. Vacuum producing devices in laboratory operations and vacuum producing devices which do not remove or convey air contaminants from another source.
> 5. Water cooling towers and water cooling ponds not used for evaporative cooling of process water or not used for evaporative cooling of water from barometric jets or from barometric condensers.
> 6. Equipment used exclusively for steam cleaning.
> 7. Grain, metal, mineral or wood processes used exclusively for extruding.
> 8. Porcelain enameling furnaces or porcelain enameling drying ovens.
> 9. Presses used for the curing of rubber products and plastic products.
> 10. Equipment used exclusively for space heating, other than boilers.
> 11. Unheated solvent dispensing containers, unheated solvent rinsing containers or unheated dip tanks of 100 gallons capacity or less.
> 12. Blacksmith forges.
> 13. Equipment used for hydraulic or hydrostatic testing.
> 14. All printing presses other than rotogravure printing presses.
>
> e. The following equipment or any exhaust system or collector serving exclusively such equipment:
>
> 1. Blast cleaning equipment using a suspension of abrasive in water.
> 2. Bakery ovens where the products are edible and intended for human consumption.
> 3. Kilns used for firing ceramic ware, heated exclusively by natural gas or liquefied petroleum gas, any combination thereof or heated electrically.
> 4. Laboratory equipment used exclusively for chemical or physical analyses.
> 5. Equipment for inspection of metal products.
> 6. Confection cookers where the products are edible and intended for human consumption.
> 7. Drop hammers or hydraulic presses used for forging or metal working.
> 8. Die casting machines.
> 9. Atmosphere generators used in connection with metal heat treating processes.
> 10. Photographic process equipment by which an image is reproduced upon material sensitized to radiant energy.
> 11. Brazing, soldering or welding equipment.
> 12. Equipment used exclusively for the sintering of glass or metals.
> 13. Equipment used for carving, cutting, routing, turning, drilling, machining, sawing, surface grinding, sanding, buffing or polishing of ceramic artwork, leather, metals, plastics or rubber.
> 14. Equipment used for drilling, carving, cutting, routing, turning, sawing, grinding, shredding, planing or sanding of wood or wood products.
> 15. Equipment used for surface preparation of metals by use of aqueous solutions.
> 16. Equipment used for washing or drying products fabricated from metal or glass, provided that no volatile organic materials are used in the process and that no oil or solid fuel is burned.
> 17. Laundry dryers, extractors or tumblers used for fabrics cleaned with only water solutions of bleach or detergents.
> 18. Containers, reservoirs, or tanks used exclusively for electrolytic plating with, or electrolytic polishing of, or electrolytic stripping of the following metals: Brass, Bronze, Cadmium, Copper, Iron, Lead, Nickel, Tin, Zinc, Precious Metals.
> 19. Foundry sand mold forming equipment to which no heat is applied.
> 20. Ovens used exclusively for curing potting materials or castings made with epoxy resins.

f. Boilers, water heaters or steam generators that are fired exclusively with natural gas or liquefied petroleum gas or any combination thereof.

g. Natural draft hoods, natural draft stacks or natural draft ventilators.

h. Containers, reservoirs or tanks used exclusively for:

1. Dipping operations for coating objects with oils, waxes or greases.
2. Dipping operations for applying coatings of natural or synthetic resins which contain no organic solvents.
3. Storage of liquefied gases.
4. Heat treatment quench operations.
5. Unheated storage of organic materials with an initial boiling point of 300°F. or greater.
6. The storage of fuel oils with a gravity of 25° API or lower.
7. The storage of lubricating oils.
8. The storage of fuel oils with a gravity of 40° API or lower and having a capacity of 10,000 gallons or less.
9. The storage of organic solvents, diluents or thinners and having a capacity of 6,000 gallons or less.
10. The storage of liquid soaps, liquid detergents, tallow, or vegetable oils, waxes or wax emulsions.
11. The storage of asphalt.

i. Furnaces for heat treating glass or metals, the use of which does not involve molten materials.

j. Crucible furnaces, pot furnaces or induction furnaces, with a capacity of 1000 pounds or less each, in which no sweating or distilling is conducted and from which only the following metals are poured or in which only the following metals are held in a molten state:

1. Aluminum or any alloy containing over 50 per cent aluminum.
2. Magnesium or any alloy containing over 50 per cent magnesium.
3. Lead or any alloy containing over 50 per cent lead.
4. Tin or any alloy containing over 50 per cent tin.
5. Zinc or any alloy containing over 50 per cent zinc.
6. Copper.

k. Vacuum cleaning systems used exclusively for industrial, commercial or residential housekeeping purposes.

l. Structural changes which cannot change the quality, nature or quantity of air contaminant emissions.

m. Repairs or maintenance not involving structural changes to any equipment for which a permit has been granted.

n. Identical replacement in whole or in part of any article, machine, equipment or other contrivance where a permit to operate had previously been granted for such equipment under Rule 10.

These exemptions do not apply to any article, machine, equipment, contrivance or their exhaust systems, the discharge from which contains airborne radioactive material and which is emitted into the atmosphere in concentrations above the natural radioactive background concentration in air. "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, smoke, mists, liquids, vapors or gases.

(3) Determining Permit Status

As will be recalled from Chapter 13, the factors affecting the permit status are (1) new construction of equipment, (2) change of ownership, (3) change in address-location, and (4) alteration of equipment. The Equipment List is so constructed as to provide reference data which will enable inspectors on subsequent inventory reinspections to determine whether or not the permit status has changed. For number "1" above, any equipment found in the plant capable of air pollution, but not listed on the previous Equipment List, will require a permit. For #2 above, change of ownership, any change in the ownership as indicated in the heading of the Equipment List affects the Permit Status of *all the equipment in the plant*. A new Equipment List is then required for the new owner or lessee, who is also required to apply for permits for all of the equipment capable of air pollution in the plant (Rule 12, permits are non-transferable). The Equipment List of the older, defunct company is stricken from the files by means of an *Activity Status Report*. Similarly a change in address location, #3 above, also requires that applications be made for all of the equipment in the plant. In the case of #4, above, alteration is frequently determined either by a change which has taken place in the equipment description, or the flow chart, or by changes noted with reference to engineering applications in the Permit File.

The permit status is noted on the Equipment List as follows:

The date of installation of each Equipment Unit is recorded in the "Date Inst." column. This date shows whether equipment may be covered by Rule 13, or whether a permit has been issued or is required under Rule 10, if the equipment is not exempted by Rule 11.

In the "A.P.C.D. Permit Status Column", the permit status is noted even if the equipment is not being used, or is exempt under any of the provisions described above. If a permit has been granted, the permit number is written in this column. If a permit has not been granted, then the following are the proper entries to be made in this column.

1. RULE 13 —equipment installed prior to February 1, 1948.
2. DENIED —(shown in red) equipment for which a denial has been issued.
3. NON-USE—equipment requiring a permit but exempt by virtue of voluntary non-use.
4. RULE 11 —indicate subparagraph applicable to this legal exemption. (If the equipment was operated under Rule 13 prior to the effective date of Rule 11, exemption to both Rule 11 and Rule 13 is indicated.)
5. BANNED —Use of incinerator banned by reason of Rule 58. (If one is still on premises.)
6. INCON. —An inconsequential source of pollution potential.

When the inspector is informed of the final disposition of the equipment involved in pending permits, originally designated by the inspector under "A/C" or "P/R", the permit number or the fact of denial is recorded in the A.P.C.D. Permit Status column. The copy of the permit is kept in the manila envelope.

d. Coded Equipment Data

After the main portions of the Equipment List have been completed, the coded control and equipment data located in a corner of the Equipment List (see Figure XIV-3), is completed.

The M.R. NO. (Master Record Number) in the upper right-hand corner refers to the primary and secondary classification number of the activity described under "Nature of Business" in the heading.

In the upper left-hand corner, "Types of Contaminants", the inspector writes in the primary types of contaminants, known or suspected, which may possibly be emitted by any of the equipment units contained in the activity. An "X" is inserted in the box opposite the code representing the contaminant. The code is as follows:

A—Smoke and Combustion Products.
B—Liquid Particulates, e.g., aerosol mists and droplets.
C—Solid Particulates, e.g., dust and aerosols.
D—Gases and Vapors.
E—Sulphur Compounds.
F—Odors.
G—Radiation Derivatives.

In the vertical Control column, the inspector records for each item of Equipment Unit the code for the appropriate control device. If the basic equipment is not equipped with any air pollution control devices, an "X"' is placed in the appropriate space in the column. If the basic equipment has control equipment, but is listed separately, a "√" is placed in the CONTROL column. The control coding is as follows:

1—Settling chambers.
2—Dry filters, e.g., baghouse, etc.
3—Dry inertial separators, e.g., cyclones, etc.
4—Water scrubbers, e.g., spray chambers, wet cyclones, etc.
5—Electric precipitators.
6—Afterburners, e.g., flame, catalytic, flares, fuel gas systems, etc.
7—Absorbers, chambers or towers packed or baffled, etc.
8—Adsorbers, activated charcoal, silica gel, etc.
9—Condensers and/or compressors.
10—Surface controls, including vapor controls.

The BASIC equipment column is for use by the Engineering Division to convert the activity file into a count of individual equipment units.

E. *Preparation of Refinery and Petrochemical Inventories*

In the Enforcement Division of the A.P.C.D., inventories of refineries and allied activities are not recorded on the standard Equipment List. For such industries it is necessary to prepare technical reports of processes in terms of both written and graphic presentation to describe and determine the air pollution potentials of the process units being inspected. Special inventory forms for various types of equipment, operations, processes, or plants are helpful at inspections to insure coverage of specific points. This procedure is required for these reasons:

1. Because process vessels are grouped in interdependent relationships in refineries and allied plants, attempts to individually itemize pieces of equipment usually lead to confusion and disorientation.
2. Air pollution potentials can often be determined from an inventory of *functions* of process vessels, rather than itemization of equipment units. Process inventories, therefore, may require field surveys of product flows, throughput capacities, and emission factors.
3. Refinery and chemical plant inventories thus categorize, itemize, and present data as will directly determine not only compliance with Rule 10, but compliance with such equipment-regulation rules as 56, 59, 61, and 62. The Equipment List described previously is used only for compilation of data to show compliance with Rule 10.

To collect such information, a special inventory system is adapted to each refinery. In order to adequately cover each of the multiple operations of a refinery or large petrochemical plant, a system of unitization is used in which the plant area is subdivided into process units. Those units with the greatest air pollution potentials are given added emphasis by assigning higher rates of inspection. A brief listing of some of these process units is given in Chapters 2 and 6. A diagram of all such processes as they are typically integrated in a refinery is shown in Figure XIV-6.

The inventory records of each refinery or petrochemical plant consist of a group of file folders, each folder dealing with one of the process units. One or more process units may constitute what has been defined as the Source Activity. Hence, one inspection or inventory is made of one or more process units programmed as a unit for reinspection. At the head of each refinery file group is a numbered index of all distinct source activities within the refinery. Each number is cross-referenced to the location of the folder containing the appropriate source activity.

1. General Inspection Procedures

Due to the operational complexity of petroleum refineries, petrochemical and chemical plants and other allied activities, a degree of specialization, training, and considerable experience is required on the part of an effective refinery inspector. This manual cannot possibly present the extensive technical ramifications of the air pollution problems in these industries. For those engaged in refinery enforcement, the following represent a few of the references which may be used as guides:

1. Los Angeles County Air Pollution Control District, Enforcement Division, *Refinery Inspection and Processing Manual*, as well as other pertinent District technical publications.
2. Any reliable current petroleum reference book in the field, such as Bell's *American Petroleum Refining*, or Nelson's *Petroleum Refinery Engineering*, or Bureau of Naval Personnel's (U.S. Navy) *Fundamentals of Petroleum*.
3. Petroleum trade journals such as the *Oil and Gas Journal*, *The Petroleum Refiner*, *Petroleum World* (Western), or any other suitable publication which chronicles current developments in this field.

Most inspections of process units in refineries are arranged in advance, as a part of the systematic programming of inspections. Such arrangements are necessary in order to assure that the process unit is in operation, that the appointed specialist in the plant is available, and for safety precautions and guidance.

The inventory data are not maintained within the inspector's vehicle as in the case of the Manila Envelope and Equipment List File. When the process unit is ready for reinspection, the inspector checks out the field file and reviews the previous reports, and then proceeds to the inspection.

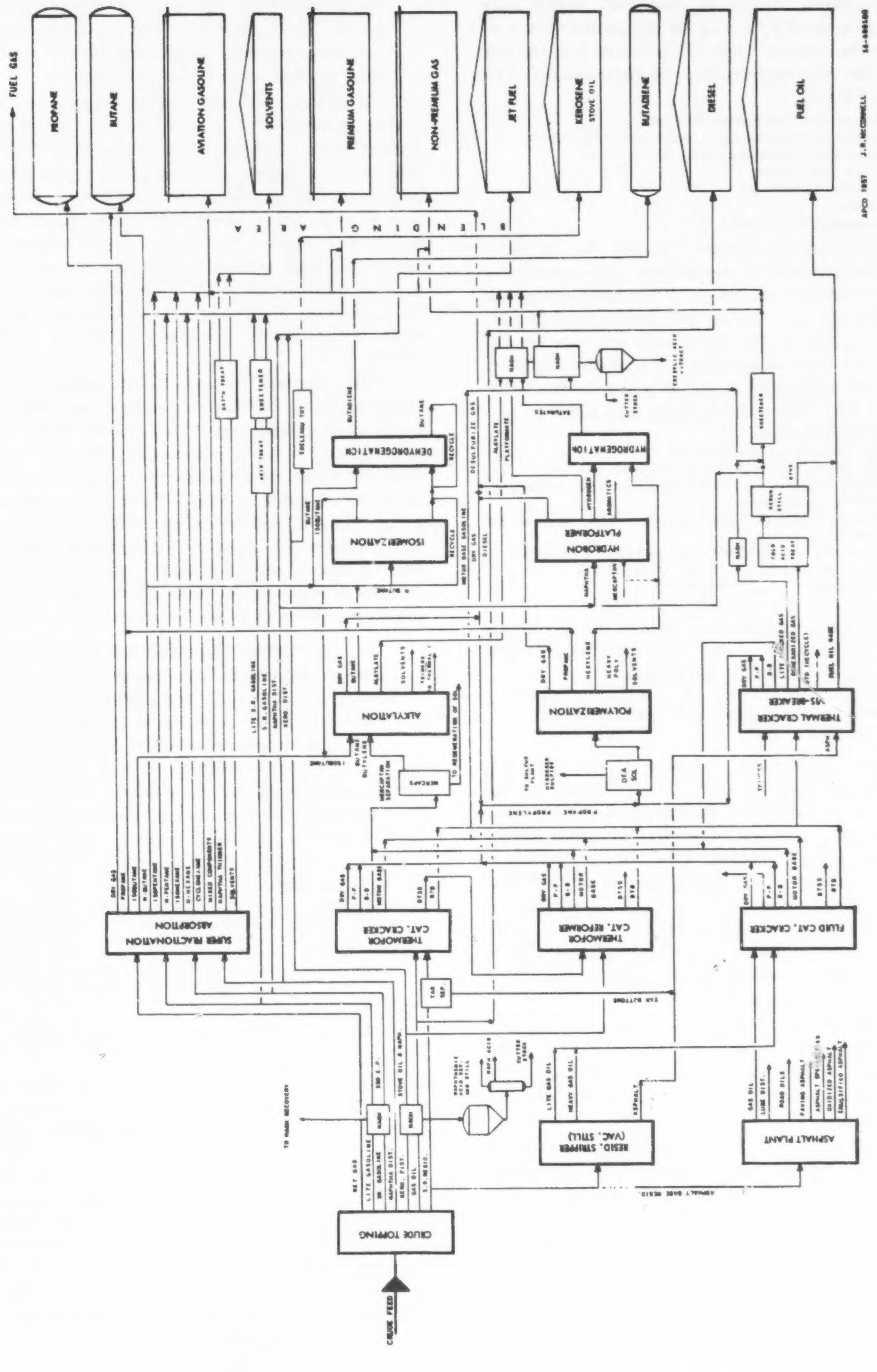


Figure XIV - 6. Refinery flow sheet.

The objectives of the air pollution inspector are not only to determine which elements of the operation are affected by the Rules and Regulations but to determine as well the degree of compliance to them. His inspection procedures are adapted to the specific air pollution requirements governing the type of unit being inspected.

Safety is a prime consideration and all refineries have standard safety procedures for employees and visitors. Accordingly, the inspector is equipped with a hard hat, goggles, safety flash light; H_2S indicator; any other safety device the specific type of unit being inspected calls for.

The inspector is accompanied to the unit or units to be inspected, by the air pollution representative within the plant or by such other informed refinery personnel as he might indicate.

General unit or plant compliance is determined through sensory evidence, examination of current and past records, plans, recorder charts and gauges, obtaining samples for laboratory analysis, on-the-spot testing or calling for a mobile field test unit for more extensive determination of suspected sources of non-compliance.

The lines of approach[4] which generally yield the most effective results are:

(1). *Investigation of the methods used and the general efficiency achieved in controlling the release of pollutants to the atmosphere from process (basic equipment) units.*

The inspector determines plant procedures employed during start-ups, shut-downs and equipment malfunctions, to control or eliminate the discharge to atmosphere of noxious or malodorous emissions through the purging or depressuring of tanks or vessels. These include the installation of special instrumentation, e.g., high level or high pressure alarms, liquid knock-out drums on fuel gas systems, pressure relief or manually controlled discharge from process equipment to blow-down vessels of either variable or fixed capacity which are served by vapor recovery compressors, flare systems or both, and, where emissions are a factor, fixed roof tankage tie-in to properly sized vapor recovery or fume disposal systems. Loading racks should be tied to vapor control systems when the product being loaded has a significant vapor pressure.

(2) *Determination of quality of maintenance on such points as manual, pressure relief and pressure vacuum valves, flanges, pump glands, gauge hatches, etc., which may be a source of leakage.*

Such emissions are primarily recognized by sensory evidence and their detection depends on the ability of the inspector to recognize the odor and to trace it to its point of origin.

The inspector must also note any air turbulence caused by light hydrocarbon leakage, frosting of a valve or pump gland caused by light hydrocarbon evaporation, liquid leakage, local area discolorations caused by vapor condensate, visible emissions or changes in flow (surging) of an emission, extinguished flare pilot lights or detection of audible gas leaks. These may disclose a violation or a potentially critical situation that could be corrected in time.

(3) *Procedures used in controlling air contaminants and odors resulting from disposal of process waste effluents*:

The refinery inspector should thoroughly survey the sour water, waste water, sour gas, spent caustic and acid sludge gathering and processing and fume disposal systems.

While in a modern refinery most of these streams are "treated", from an air pollution standpoint, their extremely noxious and malodorous characteristics make even the most isolated uncontrolled streams a potential source of air pollution problems.

Wherever possible, the inspector should point out conditions having a high degree of air pollution potential so that the refinery technical staff may have the opportunity to assess the problem and arrive at a solution that will keep the source in question within the bounds of the regulations governing it. More effective use of existing control equipment is achieved by extending its service to as many uncontrolled sources as is possible without overloading its capacity.

The inspector may find isolated streams of sour (H_2S laden) gas fuel untreated for H_2S removal and recovery, sour water discharged to open drains with live steam which has not been first deodorized by processing in sour water oxidation or H_2S stripping facilities.

Odors and hydrocarbons emitted to the atmosphere from oil-water separators may be limited by using a floating roof or an air-tight fixed roof vented to a vapor recovery system on primary compartments, as prescribed by the A.P.C.D. Rules and Regulations.

Malodorous or noxious acid sludge stored in uncontrolled tanks which release fumes and odors due to breathing and filling losses or loaded into tank cars and trucks with similar results, may be treated by caustic scrubbing. Where several forms of control are available, the adoption of the most effective in reducing release of contaminants to the atmosphere will generally meet with the results which will best assure a complaint-free community.

Disposal of malodorous fumes rich in H_2S or mercaptans, such as from the spent caustic regeneration and handling operation, formerly accomplished through incineration which released SO_2 and other fumes to the atmosphere, has been limited through regulations by the A.P.C.D. and is now treated for recovery as H_2S or oxidized to non-noxious form. Similarly, SO_2 and SO_3 discharge to the atmosphere in the flue gas resulting from burning of high sulfur fuel oil has been limited by the A.P.C.D. Rules and Regulations.

(4) *Investigation of efficiency, operating load and maintenance of control equipment*:

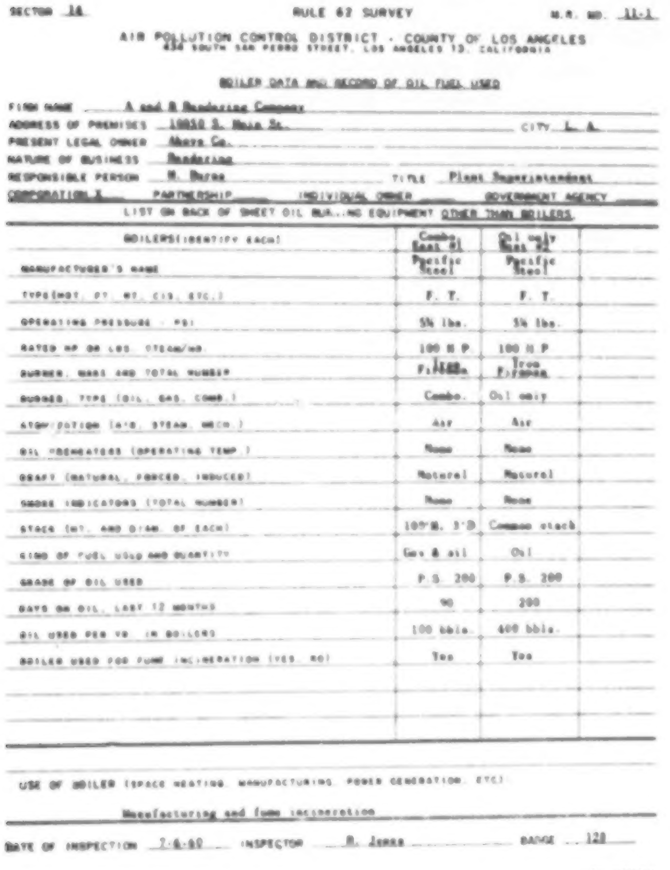
The effective operation of various control systems in a refinery is of basic importance to efficient air pollution control. Such equipment as cyclones, electrostatic precipitators, vapor recovery compressors, pressure vent valves, regulators and headers, variable capacity gas holder diaphragms, tank truck loading arm vapor closures, floating roof vapor seals, fume and odor scrubbers, H_2S absorbers and sulfur recovery plants are subject to severe corrosion and other destructive forces which reduce air pollution control efficiency. In addition, a change in feed or feed rates due to increased or altered product requirements at process units or tankage, may also result in overloaded or otherwise upset operating conditions at its air pollution control system.

In the case of a vapor recovery system serving tankage, peak loads develop in the morning hours when the heat of the sun produces maximum volumes of hydrocarbon vapors in the space above the liquid. Uneven loading schedules at tank truck loading facilities tend to create a similar situation.

Since a gradual reduction in control efficiency does not always alter the effective operation of the process unit, it may not be noted by operating personnel until a major breakdown occurs accompanied by a serious air pollution situation such as a public nuisance. It is therefore essential for adequate air pollution control that added stress be placed on such areas by both refinery and A.P.C.D. as regards the frequency of inspection.

This type of inspection is sometimes more complex. Sensory evidence such as visible discharge and odors may be disclosed by thorough physical inspection and may be sufficient in some situations to determine non-compliance or abnormal operation (breakdown), i.e., Ringelmann number readings, excess hydrocarbon vapor discharge from vapor controlled tankage, etc. However, in other cases, sensory evidence may only be a preliminary or corroborating step to the investigation, either because the regulations affected call for evidence not obtainable in this manner, e.g., percentage sulfur in the fuel oil, H_2S grain loading in gaseous products burned and its btu value, weight of particulate discharge, concentration of SO_2 in discharge of flue gas, etc., or because the control equipment does not discharge a waste effluent directly to the atmosphere. In such cases the inspector must either rely on data indicating temperature, density, pressure, vacuum or throughput recorded on gauges, continuous recorders, high level or density alarms, voltmeters and ammeters or tests made of samples taken by him or a test team using explosimeters, squeeze-bulb gas analyzers, tutweilers or impingers, etc., from test points selected by the inspector in earlier investigations.

Another aid to the inspector is the data submitted by the refinery and the evaluation of that data by the



SECTOR 14 RULE 62 SURVEY M.R. NO. 11-1

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

BOILER DATA AND RECORD OF OIL FUEL USED

FIRM NAME A and B Rendering Company
ADDRESS OF PREMISES 10850 S. Main St. CITY L. A.
PRESENT LEGAL OWNER Above Co.
NATURE OF BUSINESS Rendering
RESPONSIBLE PERSON M. Burns TITLE Plant Superintendent
CORPORATION X PARTNERSHIP INDIVIDUAL OWNER GOVERNMENT AGENCY

LIST ON BACK OF SHEET OIL BURNING EQUIPMENT OTHER THAN BOILERS

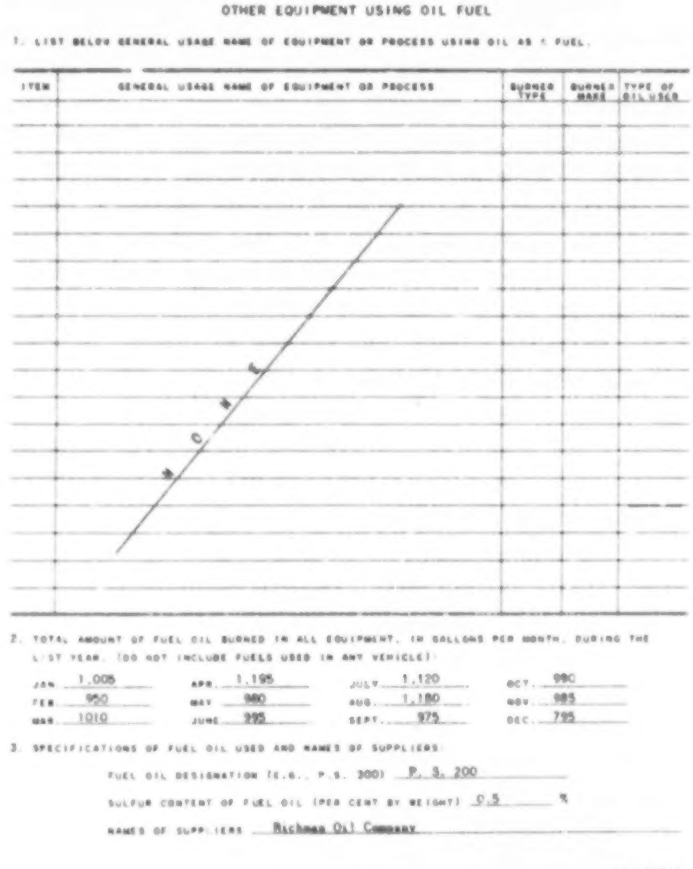
BOILERS (IDENTIFY EACH)	Combo. Boil #1	Oil only Boil #2	
MANUFACTURER'S NAME	Pacific Steel	Pacific Steel	
TYPE (HRT, FT, WT, CIS, ETC.)	F. T.	F. T.	
OPERATING PRESSURE - PSI	5½ lbs.	5½ lbs.	
RATED HP OR LBS. STEAM/HR.	100 H P	100 H P	
BURNER, MAKE AND TOTAL NUMBER	Iron Fireman	Iron Fireman	
BURNER, TYPE (OIL, GAS, COMB.)	Combo.	Oil only	
ATOMIZATION (AIR, STEAM, MECH.)	Air	Air	
OIL PREHEATERS (OPERATING TEMP.)	None	None	
DRAFT (NATURAL, FORCED, INDUCED)	Natural	Natural	
SMOKE INDICATORS (TOTAL NUMBER)	None	None	
STACK (HT. AND DIAM. OF EACH)	105'H. 3'D	Common stack	
KIND OF FUEL USED AND QUANTITY	Gas & oil	Oil	
GRADE OF OIL USED	P.S. 200	P.S. 200	
DAYS ON OIL, LAST 12 MONTHS	90	200	
OIL USED PER YR. IN BOILERS	100 bbls.	400 bbls.	
BOILER USED FOR FUME INCINERATION (YES, NO)	Yes	Yes	

USE OF BOILER (SPACE HEATING, MANUFACTURING, POWER GENERATION, ETC.)
Manufacturing and fume incineration

DATE OF INSPECTION 7-6-60 INSPECTOR R. Jones BADGE 128

16-40M343
REV. 5-60

Figure XIV - 7. Front side of Boiler Data and Record of Oil Fuel Used Sheet used to survey compliance with A.P.C.D. Rule 62.



OTHER EQUIPMENT USING OIL FUEL

1. LIST BELOW GENERAL USAGE NAME OF EQUIPMENT OR PROCESS USING OIL AS A FUEL.

ITEM	GENERAL USAGE NAME OF EQUIPMENT OR PROCESS	BURNER TYPE	BURNER MAKE	TYPE OF OIL USED

2. TOTAL AMOUNT OF FUEL OIL BURNED IN ALL EQUIPMENT, IN GALLONS PER MONTH, DURING THE LAST YEAR. (DO NOT INCLUDE FUELS USED IN ANY VEHICLE)

JAN.	1,005	APR.	1,195	JULY	1,120	OCT.	990
FEB.	950	MAY	980	AUG.	1,180	NOV.	985
MAR.	1010	JUNE	995	SEPT.	975	DEC.	795

3. SPECIFICATIONS OF FUEL OIL USED AND NAMES OF SUPPLIERS:

FUEL OIL DESIGNATION (E.G., P.S. 300) P. S. 200
SULFUR CONTENT OF FUEL OIL (PER CENT BY WEIGHT) 0.5 %
NAMES OF SUPPLIERS Richman Oil Company

16-40M343
REV. 5-60

Figure XIV - 8. Back side of Boiler Data and Record of Oil Fuel Used Sheet used to survey compliance with A.P.C.D. Rule 62.

A.P.C.D. in the existing application for permit to operate the equipment.

The permit status of the equipment should be investigated to determine any changes in process or equipment that might invalidate the existing permit. Inspection should also determine compliance to permit or variance conditions.

2. Preparation of Refinery and Petrochemical Inventories

a. *Activity Status Reports, Plot Plans, and Flow Charts.* The refinery inspector reports all inventory and inspection findings on an *Activity Status Report*, supported by a flow diagram and plot plan of the process. These reports and diagrams include the following:

1. A general description of the process including an analysis of its purpose and function in the order of the flow or processing sequence. Generally, the analysis traces the flow of materials (feed stocks, etc.) from introduction through various sidestreams to final effluents.
2. A list of the various pieces of equipment contained in the process unit and their function, incorporated in the above description unless they are presented to better advantage on the process flow diagram or plot plan.
3. The air pollution potentials of the process or the equipment should include an analysis of any important problems. This discussion should include, if possible, an actual estimate of the contaminants emitted and the approximate quantities, chemical designations, odor quality and intensity, opacities, or physiological effects, as well as the potential hazards of the stocks or products released should equipment failure occur. Such equipment breakdowns are reported to the District by industry. (See Chapters 11 and 12 for sampling procedures, and Table XIV-2.)
4. Throughput of volatile materials and estimates of emissions from known sources. This may be determined from results of "material balances," i.e., estimates of sulfur derivatives lost as calculated from the differences between input and final output.
5. Results of any tests made of effluents such as industrial wastes or air pollutants or samples taken of fuels or other materials.
6. A process flow chart and plot plan, if an adequate one is not supplied by the refinery representative, which can be used for reference and verification on followup inspection, and which indicate the flow rate of materials, pressures, temperatures, etc., in process vessels and lines, where necessary, to estimate air pollution potentials and to locate points of emission.

Flow charts and plot plans are systematically drawn according to conventional engineering rules. All pertinent liquid or gas feed lines are shown on the left-hand side of the flow chart, and all gas or liquid effluents on the right-hand side, if the flow lends itself to such a structure. In the case of refineries, overhead discharge and drainage from columns or vessels are generally shown by vectors indicating method of disposal. All features not essential to the understanding of the air pollution problem are omitted.

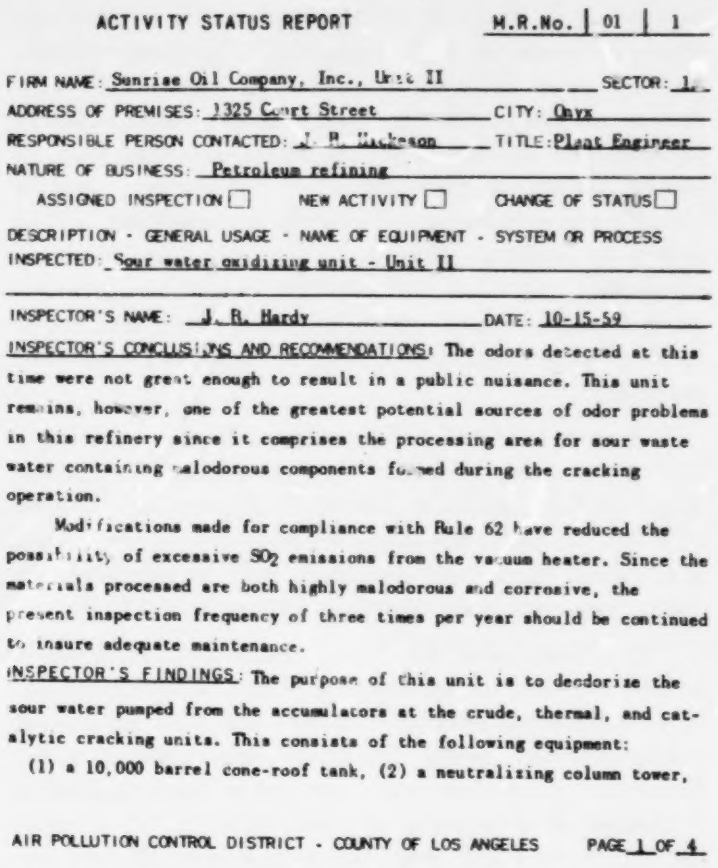
Flow lines are drawn in straight lines and at right angles, and are broken when it is necessary for a continuous flow line to cross another. The flow lines are clearly labeled and vectored as to direction and content. For example: "Refinery Gas in," "To Fuel Gas System," "To Oil-Water Separator," etc. The process lines indicate whether the flow originated in, or entered at the top, side, or bottom of columns or equipment. Equipment or columns should be clearly labeled as to function unless they can be depicted by symbols (such as heat exchangers, condensers, etc., and by plant number as shown in Figure XIV-11). *It is of utmost importance in a flow diagram to clearly illustrate all sources of air pollution, whether they be stacks, flares, or pressure relief valves, etc., and to identify the problem areas and the contaminants which might be emitted.* Process vessel and line operating conditions recorded on pressure and temperature gauges, manometers, continuous recorders, and relief valve pressure settings, should be indicated wherever pertinent.

A sample of an Activity Status Report covering a sour water treatment and disposal plant, and accompanying flow charts, is shown in Figures XIV-9 and XIV-10. To assist the inspector both in evaluating and illustrating the process, symbols may be employed in chart preparation as shown in Figure XIV-11.

b. *Plant Card.* Plant ownership data, equivalent to that supplied on the heading of the Equipment List, is recorded separately on a *Plant Card.* Such data need not accompany every inventory form used in a refinery and petrochemical plant, since there is seldom a change of ownership in this industry. It is most important to know who the responsible officials are and how they can be quickly contacted either by a field inspector or by telephone. Where accurate field data exist in the inventory files, it is possible to make a preliminary investigation of refinery problems by telephone.

c. *Refinery Check Sheet.* To insure that the other refineries in the area continue to receive surveillance when the inspector is busy at one refinery, the areas in which the refineries are situated are sectioned and carefully checked by patrols using a *Refinery Check Sheet.* On this sheet each refinery to be checked is listed. The time of observation is noted, along with any pertinent remarks concerning significant observations of each refinery. Such remarks include notations of odor, visible emissions, wind direction, etc. If longer reports are required for any given plant, the inspector writes on the reverse of this form, or an *Inspector's [illegible] Field Report*, or an *Activity Status Field Report.*

d. *Bulk Plant Data: Rules* 56, 59 *and* 61. This inventory form (Figure XIV-13) is used to record data obtained from inspection of loading racks, storage tanks, pumps, vapor controls, and associated equipment located at bulk plants. Bulk plants are used to store and distribute various petroleum products such as kerosine, gasoline, diesel oil, solvents, lube oil, etc., and may be found at airport facilities, distributing centers, marine terminals, etc. Because these plants contain equipment which may be subject to Rules 56, 59, and 61, in addition to Rule 10, the form is used to emphasize compliance of equipment and operation with the requirements of these rules. This Bulk Plant



ACTIVITY STATUS REPORT M.R.No. | 01 | 1

FIRM NAME: Sunrise Oil Company, Inc., Unit II SECTOR: 1
ADDRESS OF PREMISES: 1325 Court Street CITY: Onyx
RESPONSIBLE PERSON CONTACTED: J. R. [illegible] TITLE: Plant Engineer
NATURE OF BUSINESS: Petroleum refining
ASSIGNED INSPECTION ☐ NEW ACTIVITY ☐ CHANGE OF STATUS ☐
DESCRIPTION - GENERAL USAGE - NAME OF EQUIPMENT - SYSTEM OR PROCESS INSPECTED: Sour water oxidizing unit - Unit II

INSPECTOR'S NAME: J. R. Hardy DATE: 10-15-59

INSPECTOR'S CONCLUSIONS AND RECOMMENDATIONS: The odors detected at this time were not great enough to result in a public nuisance. This unit remains, however, one of the greatest potential sources of odor problems in this refinery since it comprises the processing area for sour waste water containing malodorous components formed during the cracking operation.

Modifications made for compliance with Rule 62 have reduced the possibility of excessive SO_2 emissions from the vacuum heater. Since the materials processed are both highly malodorous and corrosive, the present inspection frequency of three times per year should be continued to insure adequate maintenance.

INSPECTOR'S FINDINGS: The purpose of this unit is to deodorize the sour water pumped from the accumulators at the crude, thermal, and catalytic cracking units. This consists of the following equipment: (1) a 10,000 barrel cone-roof tank, (2) a neutralizing column tower,

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES PAGE 1 OF 4

(3) a waste-water stripper, (4) an aeration column, (5) a waste-water cooler, (6) a sour water degasifier drum, and (7) necessary pumps, piping, and instrumentation. These are shown in the attached flow diagram.

The sour water is pumped from the accumulators to the degasifier drum. The gas removed from this drum flows through a back pressure regulator valve to a low pressure H_2S removal plant.

The sour water and waste caustic are collected in the 10,000 bbl. capacity tank venting to the vapor recovery system.

The sour water is pumped from the tank to the neutralizing column where it contacts 98% sulfuric acid. The mercaptans released from the water by the sulfuric acid, along with other waste gases in the overhead line from the caustic regeneration unit, are condensed and fed into the cracking unit for conversion to H_2S and recovery. This accounts for the disposal of most of the mercaptans in the system.

The neutralized water is then pumped to the waste-water stripper, and live steam is introduced in the column to strip out H_2S and mercaptans. Sweet gas with 7 or less grains of H_2S per 100 CF from the secondary scrubber at the H_2S removal plant is introduced into the bottom of the stripper at the rate of 350,000 to 500,000 CF/D to sweep the released gases from the water. This sour gas from the stripper goes to the H_2S absorption plant. A pressure relief valve on the stripper vents to the flare.

The stripped water then flows to an aeration column where it is contacted counter-currently with an air stream and caustic and is oxidized to non-odorous thiosulfate. The resulting foul air from this vessel is sent to the firebox of the vacuum unit heater for deodorizing.

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES PAGE 2 OF 4

Figure XIV-9. Activity Status Report of an inspection made of a sour water oxidizing unit at an oil refinery.

TABLE XIV-2
HYDROCARBON EMISSION FACTORS FOR REFINERY SOURCES

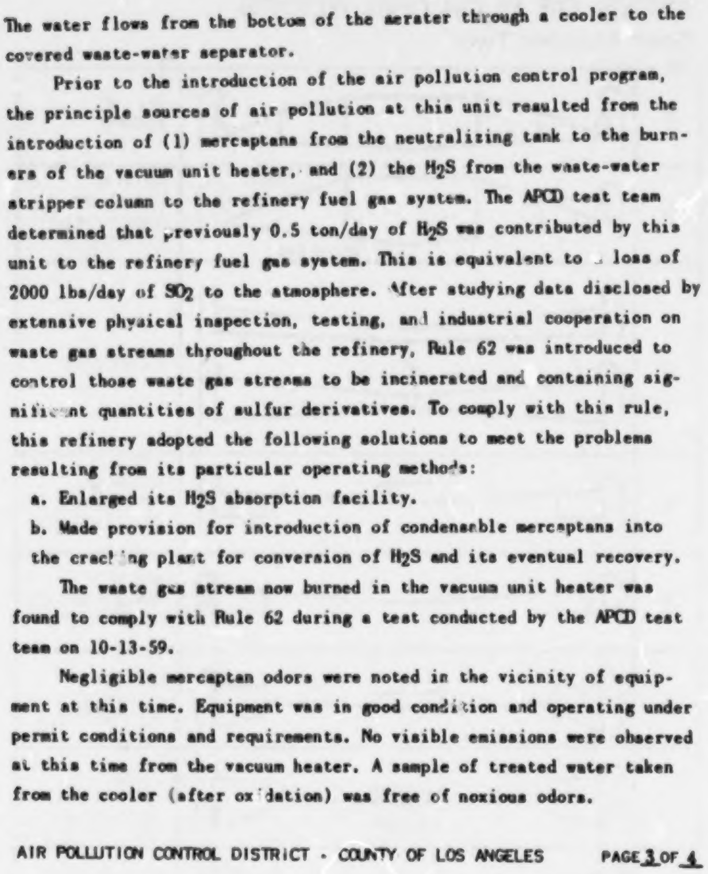
SOURCE OF EMISSION	EMISSION FACTOR		
	NO CONTROL	CONTROL	UNITS(a)
Fluid catalytic cracking unit	200	10	Lbs. per 1,000 bbls. feed
Thermofor catalytic cracking unit	50	—	Lbs. per 1,000 bbls. feed
Crude oil storage tanks	500	75(b)	Lbs. per 1,000 bbls. refinery crude throughput
Petroleum distillate storage tanks	670	100(b)	Lbs. per 1,000 bbls. refinery crude throughput
Oil-water separators	400	8	Lbs. per 1,000 bbls. refinery crude throughput
Oil-water separators	300	5	Lbs. per 1,000 bbls. waste water
Vacuum jets	150	0	Lbs. per 1,000 bbls. refinery crude throughput
Loading tank trucks & trailers (avg.)	150	2	Lbs. per 1,000 bbls. loaded
Motor gasoline, 8-12 lbs. RVP	375	5	Lbs. per 1,000 bbls. loaded
Aviation gasoline, 4-8 lbs. RVP	170	2	Lbs. per 1,000 bbls. loaded
Other distillates, 1-4 lbs. RVP	90	1	Lbs. per 1,000 bbls. loaded
Pump seals	125	20(c)	Lbs. per 1,000 bbls. refinery crude throughput
Mechanical seals	—	3.2	Lbs. per seal per day
Packed seals	5.0	—	Lbs. per seal per day
Compressor seals	6	—	Lbs. per 1,000 bbls. refinery crude throughput
Compressor seals	8.5	—	Lbs. per seal per day
Valves (flow)	28	—	Lbs. per 1,000 bbls. refinery crude throughput
Valves (flow)	0.5	—	Lbs. per valve per day
Relief valves	80	5	Lbs. per 1,000 bbls. refinery crude throughput
Relief valves (on process vessels)	2.9	—	Lbs. per valve per day
Cooling towers	10	—	Lbs. per 1,000 bbls. refinery crude throughput
Cooling towers	6	—	Lbs. per 1,000,000 gals. cooling water
Treating units	8	2	Lbs. per 1,000 bbls. refinery crude throughput
Compressor exhausts	1	—	Lbs. per 1,000 cubic feet gas burned
Blowdowns, turnarounds, vessel & tank	25	5	Lbs. per 1,000 bbls. refinery crude throughput

(a) Factors are expressed in units of pounds per 1,000 barrels of refinery crude throughput where, in the opinion of the authors, the magnitude of the same source in different refineries is related approximately to their throughputs. In some cases the factors are expressed in a second unit which might prove more convenient.

(b) Floating roof controls. The factor would theoretically be zero for vapor recovery controls.

(c) Control consists of using mechanical seals in place of packed seals for light hydrocarbon service.

Source: ***Reference*** 1.



The water flows from the bottom of the aerater through a cooler to the covered waste-water separator.

Prior to the introduction of the air pollution control program, the principle sources of air pollution at this unit resulted from the introduction of (1) mercaptans from the neutralizing tank to the burners of the vacuum unit heater, and (2) the H_2S from the waste-water stripper column to the refinery fuel gas system. The APCD test team determined that previously 0.5 ton/day of H_2S was contributed by this unit to the refinery fuel gas system. This is equivalent to a loss of 2000 lbs/day of SO_2 to the atmosphere. After studying data disclosed by extensive physical inspection, testing, and industrial cooperation on waste gas streams throughout the refinery, Rule 62 was introduced to control those waste gas streams to be incinerated and containing significant quantities of sulfur derivatives. To comply with this rule, this refinery adopted the following solutions to meet the problems resulting from its particular operating methods:

a. Enlarged its H_2S absorption facility.

b. Made provision for introduction of condensable mercaptans into the cracking plant for conversion of H_2S and its eventual recovery.

The waste gas stream now burned in the vacuum unit heater was found to comply with Rule 62 during a test conducted by the APCD test team on 10-13-59.

Negligible mercaptan odors were noted in the vicinity of equipment at this time. Equipment was in good condition and operating under permit conditions and requirements. No visible emissions were observed at this time from the vacuum heater. A sample of treated water taken from the cooler (after oxidation) was free of noxious odors.

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES PAGE 3 OF 4

Data Sheet, supported by the inventory forms noted in d, f, and g., presents a master inventory for each bulk plant.

Notice (in the sample shown in Figure XIV-12) that by increasing the number of spouts observed during the 7-8-57 reinspection the permit status changed. A Permit Request was appropriately written ("P.R.").

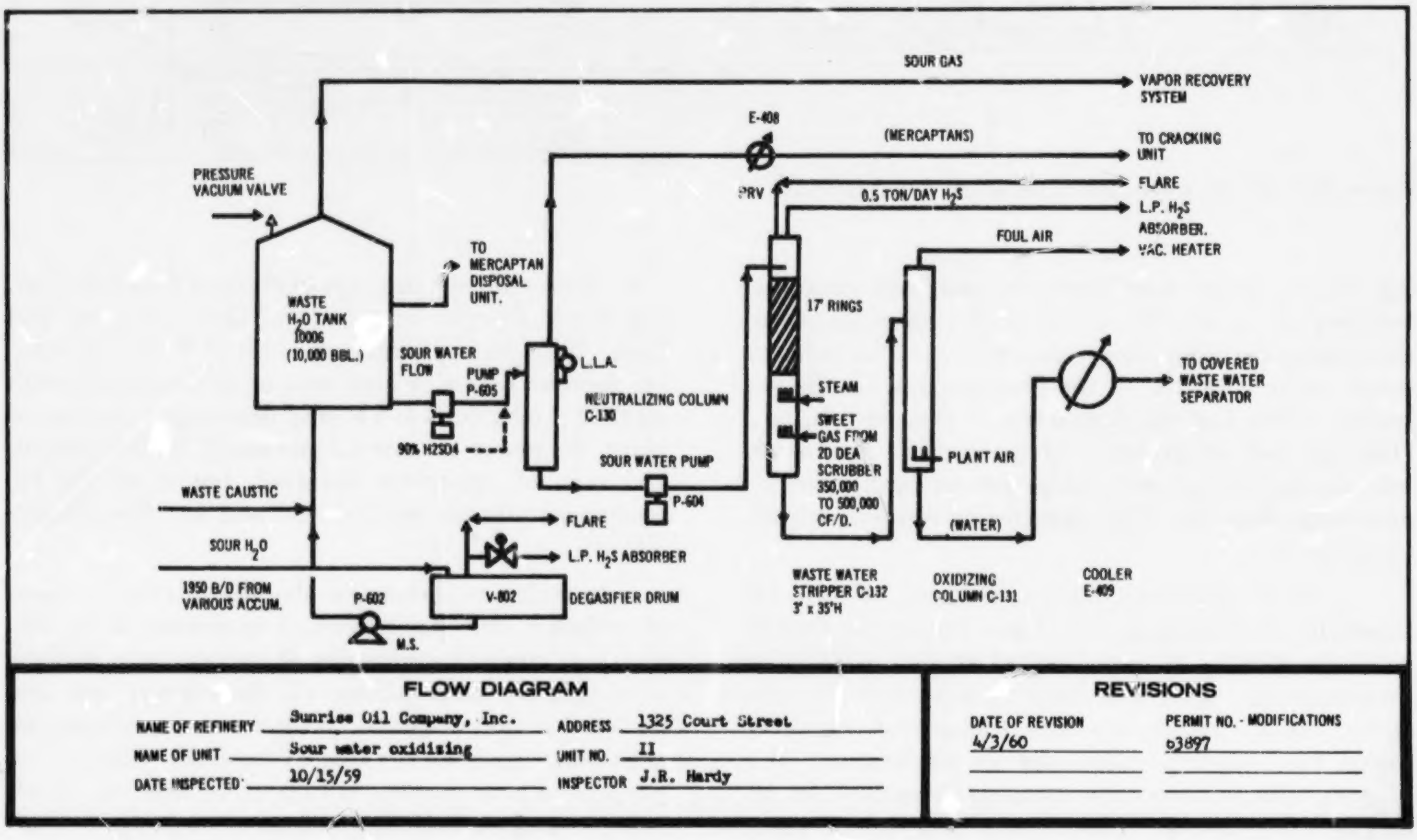
e. *Truck Loading Inspection Data Sheet* (Rule 61). This inspection sheet is made for each truck loading facility subject to Rule 61. It lists the number of racks and spouts, the permit status of each rack, and throughputs of tank truck loading racks to determine compliance with Rule 61, as well as Rule 10. To be affected by Rule 61, the premises must be used to load 20,000 gallons or more of gasoline in one day into tank trucks and trailers (see Chapter 11).

On this form, the total losses of hydrocarbons are determined from the following emission factors:

Emission of hydrocarbons in gallons from uncontrolled equipment—Approximately 1/10 of 1 per cent of the average gallon throughput per day.

Emission of hydrocarbons in gallons from controlled equipment—8 per cent of the above.

f. *Oil-Effluent Water Separator Inspection*: *Rule* 59. This inventory form is used specifically with reference to the requirements of Rule 59. The example shown in Figure 14 is of a single refinery oil-effluent water separator which derives its influent from trea-



FLOW DIAGRAM

NAME OF REFINERY Sunrise Oil Company, Inc. ADDRESS 1325 Court Street

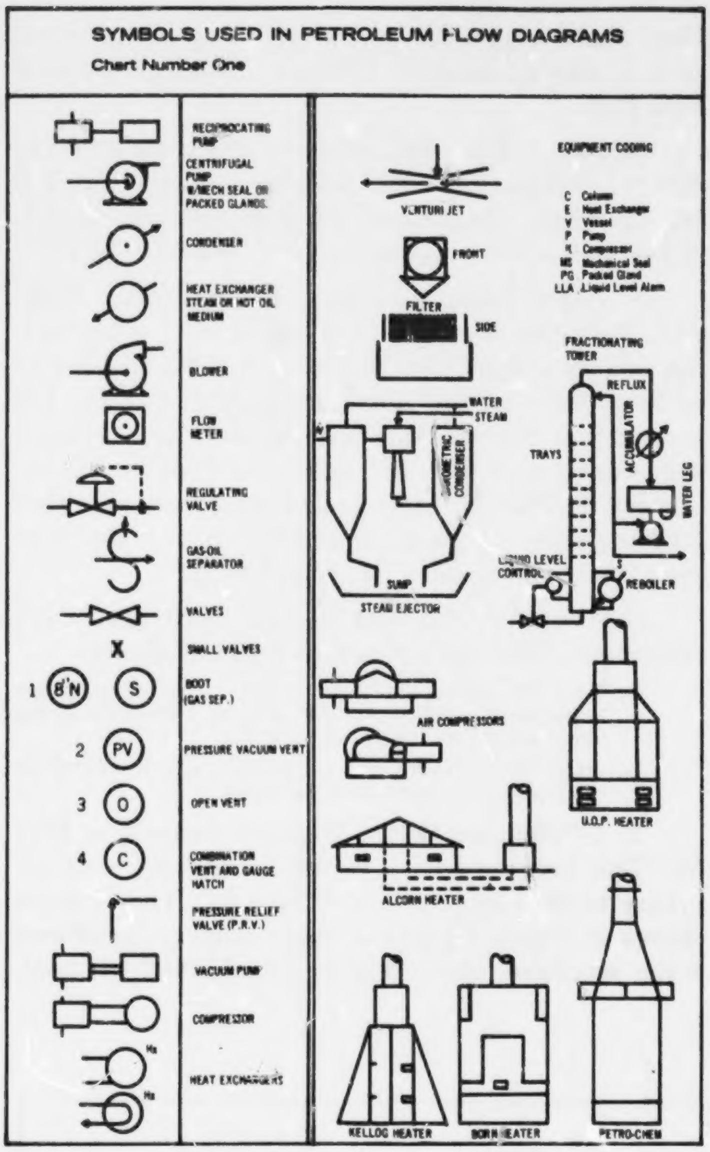
NAME OF UNIT Sour water oxidizing UNIT NO. II

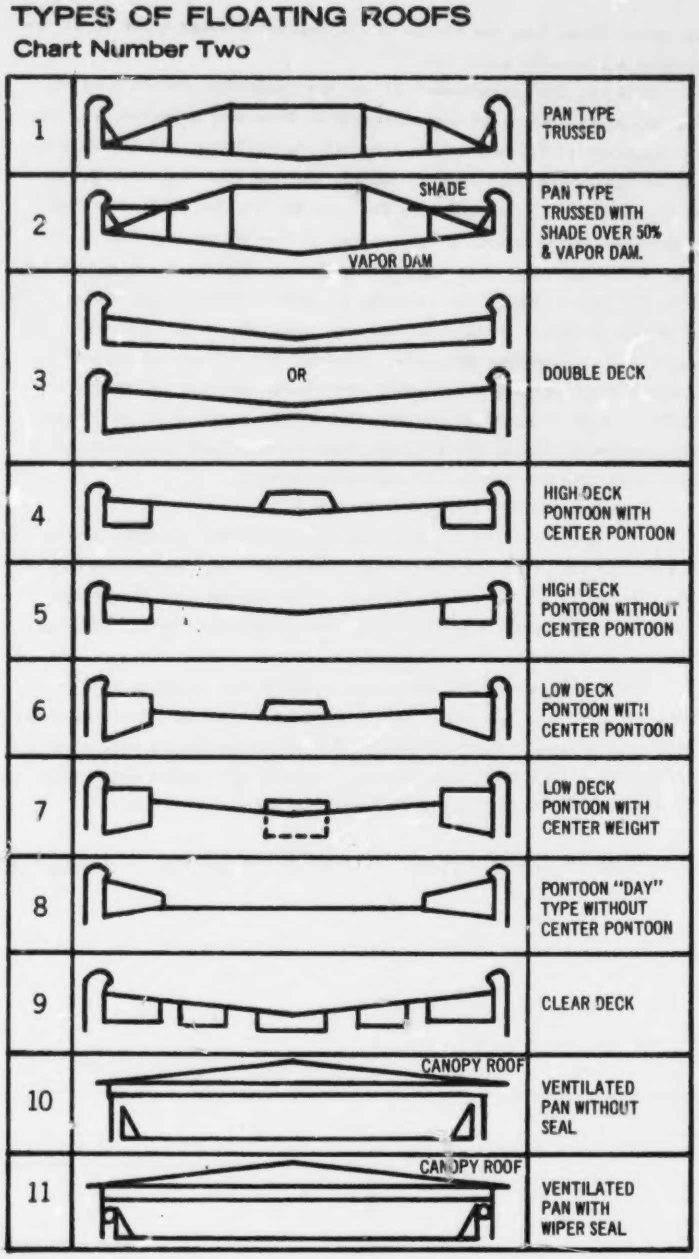
DATE INSPECTED 10/15/59 INSPECTOR J.R. Hardy

REVISIONS

DATE OF REVISION	PERMIT NO. - MODIFICATIONS
4/3/60	63897

Figure XIV-10. Process flow diagram of a sour water oxidizing unit from a field drawing (page 4 of the Activity Status Report).


SYMBOLS USED IN PETROLEUM FLOW DIAGRAMS
Chart Number One


TYPES OF FLOATING ROOFS
Chart Number Two

1
PAN TYPE TRUSSED
2
SHADE
VAPOR DAM
PAN TYPE TRUSSED WITH SHADE OVER 50% & VAPOR DAM.
3
OR
DOUBLE DECK
4
HIGH DECK PONTOON WITH CENTER PONTOON
5
HIGH DECK PONTOON WITHOUT CENTER PONTOON
6
LOW DECK PONTOON WITH CENTER PONTOON
7
LOW DECK PONTOON WITH CENTER WEIGHT
8
PONTOON "DAY" TYPE WITHOUT CENTER PONTOON
9
CLEAR DECK
10
CANOPY ROOF
VENTILATED PAN WITHOUT SEAL
11
CANOPY ROOF
VENTILATED PAN WITH WIPER SEAL

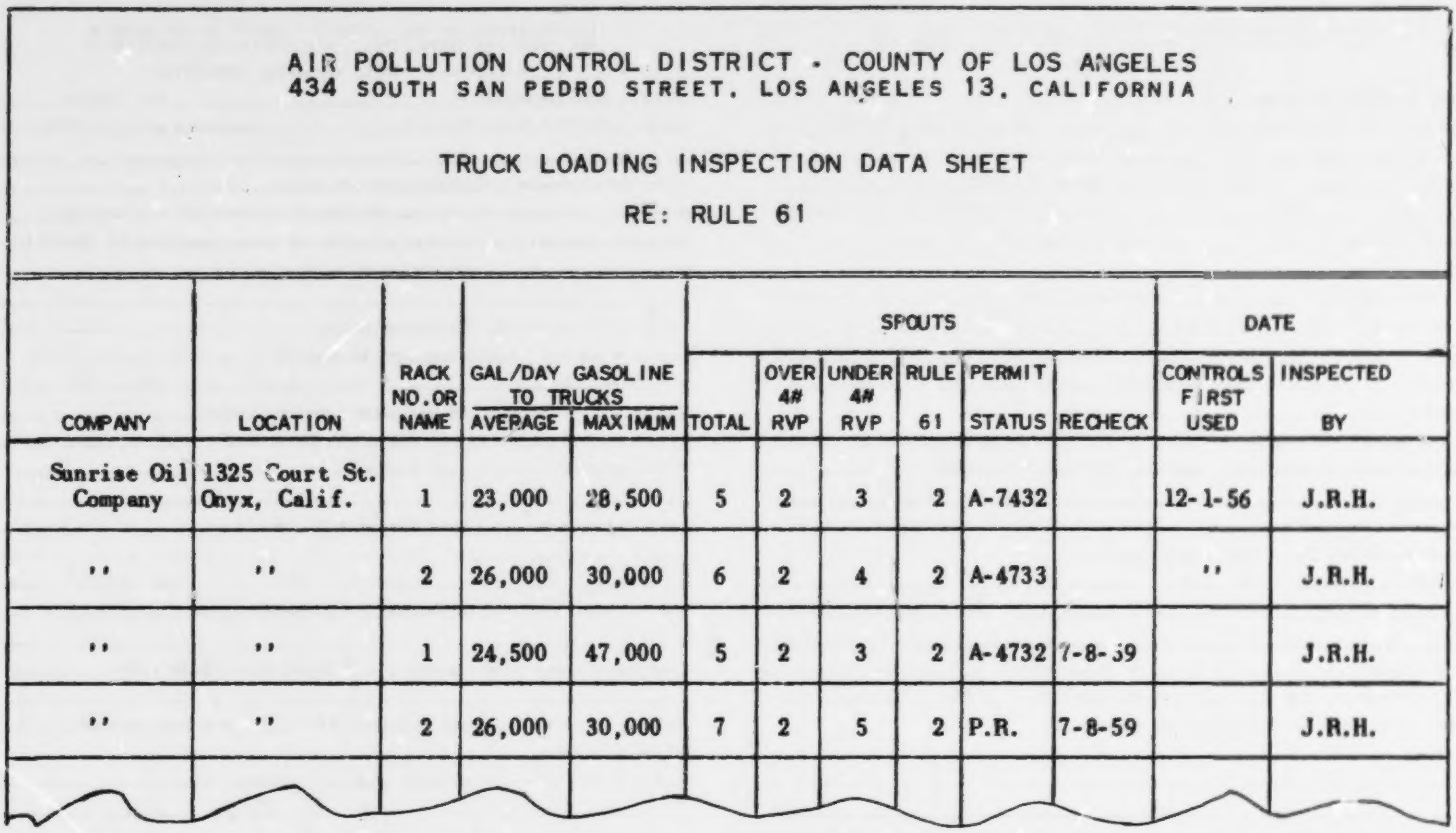
Figure XIV-11. Symbols used in petroleum flow diagrams.

ing vessels, south tank farm, thermal and catalytic cracking units, and No. 2 and 3 alkylation plants in the general cracking area of the refinery. The influent waste water is traced on the flow diagram by the inspector. Note that the description of the controls, i.e., "floating roof on primary compartment," and other information reveals the equipment to be in compliance with Rule 59. (For elements of compliance, see Chapter 11.)

g. *Tank Inspection Report*: *Rule* 56. Figure 16 illustrates an example of a *Tank Inspection Report* made for a group of tanks located at the Los Angeles Petroleum Co. This inventory form records the category, vapor control, function, dimensions, products stored, Reid vapor pressure, storage temperature, etc., of each tank to determine compliance with Rules 10 and 56. (See Chapter 11 for determining Rule 56 compliance.)

h. *Summaries or Surveys of Natural Gasoline, Gas, and Cycle Plants.* The Natural Gasoline, Gas, and Cycle Plant Survey Summary is an inventory of natural gasoline plants located near or in connection with oil field production. It not only determines the type of plant, the source of material processed, the throughput, and type of equipment involved, but it records the equipment affected by Rules 56 and 59. Note Figure XIV-16.

In order to determine the full extent or status of refinery and petrochemical problems, it is necessary to conduct summaries or surveys on a periodic or temporary basis. Some of the surveys are conducted for interdivisional projects, or in cooperation with other agencies working in the field. The general purpose of such surveys is to provide data on various categories of air pollution sources to evaluate their air pollution potentials. These include, at the present time,



AIR POLLUTION CONTROL DISTRICT • COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

TRUCK LOADING INSPECTION DATA SHEET

RE: RULE 61

COMPANY	LOCATION	RACK NO. OR NAME	GAL/DAY GASOLINE TO TRUCKS		SPOUTS						DATE	
			AVERAGE	MAXIMUM	TOTAL	OVER 4# RVP	UNDER 4# RVP	RULE 61	PERMIT STATUS	RECHECK	CONTROLS FIRST USED	INSPECTED BY
Sunrise Oil Company	1325 Court St. Onyx, Calif.	1	23,000	28,500	5	2	3	2	A-7432		12-1-56	J.R.H.
''	''	2	26,000	30,000	6	2	4	2	A-4733		''	J.R.H.
''	''	1	24,500	47,000	5	2	3	2	A-4732	7-8-59		J.R.H.
''	''	2	26,000	30,000	7	2	5	2	P.R.	7-8-59		J.R.H.

Figure XIV - 12. Truck loading inspection data sheet used for surveying compliance with Rule 61.

all industrial activities which handle organic solvents, oil field production facilities comprising oil wells, pumping stations, storage facilities, and gasoline filling stations, etc. Each survey is designed for the special needs of the project and are provided with special instructions.

F. *Preparing and Issuing the Request to Apply for A.P.C.D. Permit*

The most direct result of equipment inventory is the finding of all equipment operating illegally without A.P.C.D. permits. A written Section 24279 Notice may or may not be written, depending on the circumstances. (See "B. Unauthorized Construction or Operation of Equipment," Chapter 13.) However, an A.P.C.D. Request is always written and served by the inspector whenever such equipment is found.

The Request does two things: (1) it advises the plant management to file applications for a permit with the District by a certain date, and (2) it is a report of the exact permit status for the Engineering Division. It is always issued for equipment which has already been illegally constructed. It is *never* issued when construction of equipment is contemplated only by plant management. In such instances, management is properly advised to apply for an Authority to Construct before actual construction. Thus, whenever the inventory inspection culminates in the issuance of a permit request, the inventory process ties in with the permit system as a whole, as described in the introduction to this chapter.

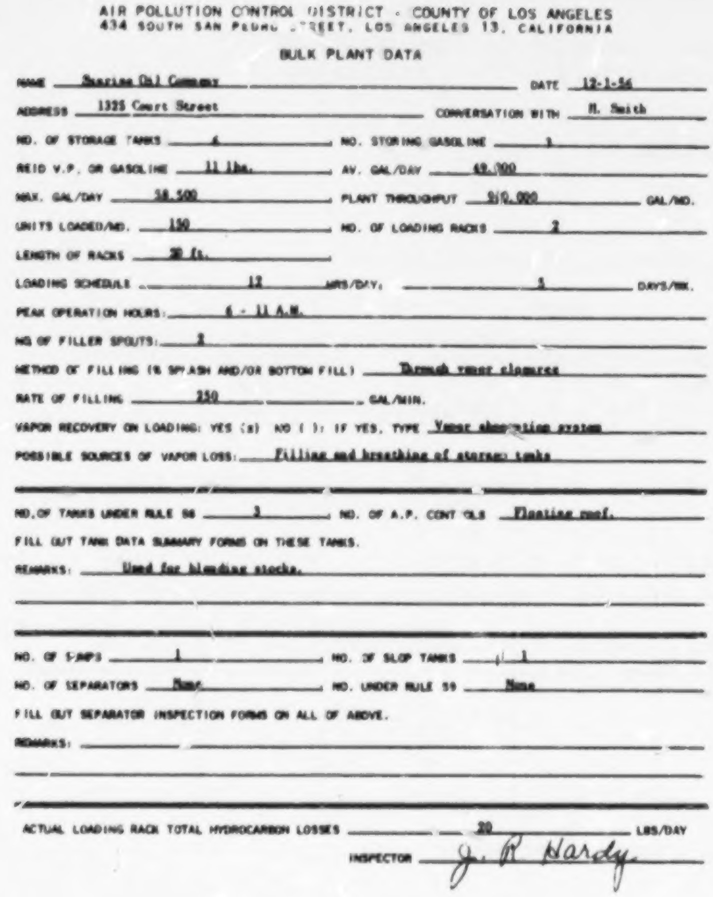
1. Preparing and Issuing the Permit Request

A separate Request to Apply for Permit (Figures XIV-17 and 18) is issued for each piece of basic or control equipment requiring a permit. However, where two or more pieces of equipment are identical as to structure and use, a single Request form may be written. Before preparing such forms, the inspector checks with the Engineering Division by phone in order to determine, in doubtful cases, the permit unit boundaries. If this is impractical at the time, the inspector issues such permit requests as seems logical to him, as adjustment can be made later by the Engineering Division.

The front of this form is completed in triplicate. The white copy is issued to the responsible manager or individual owner of the equipment for which the permit is required, along with the correct application blanks and special instruction sheets. After the back of the form is completed, the pink and green copies are forwarded to Headquarters with the Inspector's Daily Reports.

The completion of the report heading and description of the equipment is similar to procedures previously described. The form number of the applications issued should be shown on the face of the advice copy.

On the bottom of the face of the form the date to be entered on the "To Arrive By" line is ten calendar days subsequent to the date of the Request. This "grace" period gives the plant manager a reasonable period of time in which to apply for the permit. The



AIR POLLUTION CONTROL DISTRICT · COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

BULK PLANT DATA

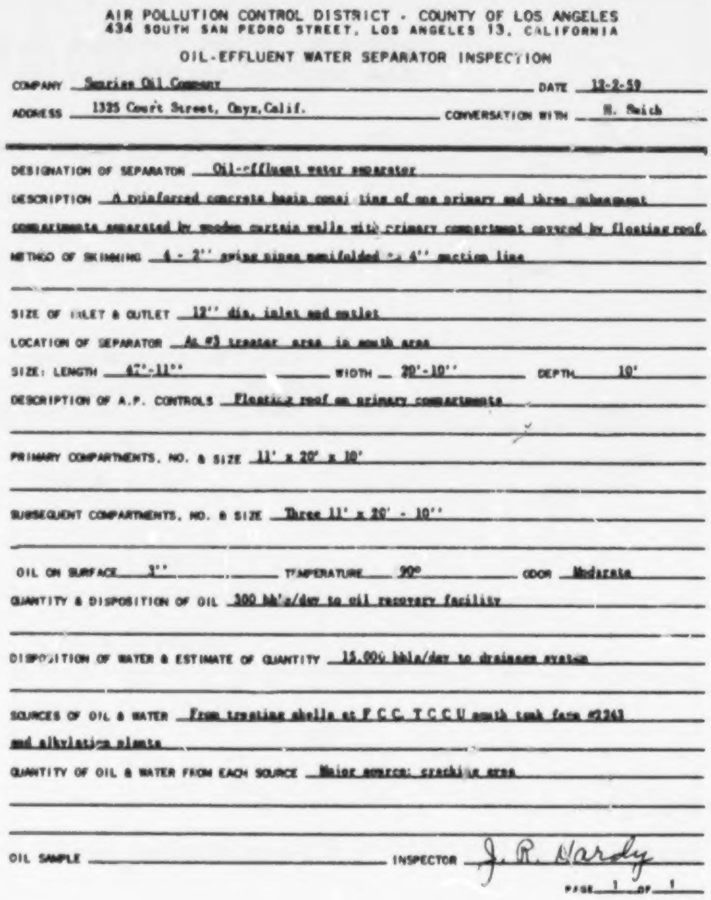
NAME Sunrise Oil Company DATE 12-1-56
ADDRESS 1325 Court Street CONVERSATION WITH H. Smith
NO. OF STORAGE TANKS 6 NO. STORING GASOLINE 3
REID V.P. OR GASOLINE 11 lbs. AV. GAL/DAY 49,000
MAX. GAL/DAY 58,500 PLANT THROUGHPUT 910,000 GAL/MO.
UNITS LOADED/MO. 150 NO. OF LOADING RACKS 2
LENGTH OF RACKS 30 ft.
LOADING SCHEDULE 12 HRS/DAY, 5 DAYS/WK.
PEAK OPERATION HOURS: 6 - 11 A.M.
NO. OF FILLER SPOUTS: 3
METHOD OF FILLING (B SPLASH AND/OR BOTTOM FILL) Through vapor closures
RATE OF FILLING 250 GAL/MIN.
VAPOR RECOVERY ON LOADING: YES (x) NO ( ): IF YES, TYPE Vapor absorption system
POSSIBLE SOURCES OF VAPOR LOSS: Filling and breathing of storage tanks

NO. OF TANKS UNDER RULE 56 3 NO. OF A.P. CONT'OLS Floating roof.
FILL OUT TANK DATA SUMMARY FORMS ON THESE TANKS.
REMARKS: Used for blending stocks.

NO. OF SUMPS 1 NO. OF SLOP TANKS 1
NO. OF SEPARATORS None NO. UNDER RULE 59 None
FILL OUT SEPARATOR INSPECTION FORMS ON ALL OF ABOVE.
REMARKS:

ACTUAL LOADING RACK TOTAL HYDROCARBON LOSSES 20 LBS/DAY
INSPECTOR J. R. Hardy

Figure XIV - 13. Bulk Plant data sheet.



AIR POLLUTION CONTROL DISTRICT · COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

OIL-EFFLUENT WATER SEPARATOR INSPECTION

COMPANY Sunrise Oil Company DATE 12-2-59
ADDRESS 1325 Court Street, Onyx, Calif. CONVERSATION WITH H. Smith

DESIGNATION OF SEPARATOR Oil-effluent water separator
DESCRIPTION A reinforced concrete basin consisting of one primary and three subsequent compartments separated by wooden curtain walls with primary compartment covered by floating roof.
METHOD OF SKIMMING 4 - 2'' swing pipes manifolded to 4'' suction line
SIZE OF INLET & OUTLET 12'' dia. inlet and outlet
LOCATION OF SEPARATOR At #3 treater area in south area
SIZE: LENGTH 47'-11'' WIDTH 20'-10'' DEPTH 10'
DESCRIPTION OF A.P. CONTROLS Floating roof on primary compartments
PRIMARY COMPARTMENTS, NO. & SIZE 11' x 20' x 10'
SUBSEQUENT COMPARTMENTS, NO. & SIZE Three 11' x 20' - 10''
OIL ON SURFACE 3'' TEMPERATURE 90° ODOR Moderate
QUANTITY & DISPOSITION OF OIL 300 bbl's/day to oil recovery facility
DISPOSITION OF WATER & ESTIMATE OF QUANTITY 15,000 bbls/day to drainage system
SOURCES OF OIL & WATER From treating shells at F C C, T C C U south tank farm #2243 and alkylation plants
QUANTITY OF OIL & WATER FROM EACH SOURCE Major source: cracking area
OIL SAMPLE INSPECTOR J. R. Hardy
PAGE 1 OF 1

Figure XIV - 14. Oil-water separator inspection sheet.

remainder of the data required on the form requires no further explanation.

The reverse side of the Permit Request is filled out in duplicate. This presents the data necessary for the engineering file, and presents a complete delineation of the permit status, in addition to a description of the process, as well as the existence or suspicion of any violation.

2. Follow-up on Issuance of the Request to Apply for A.P.C.D. Permit

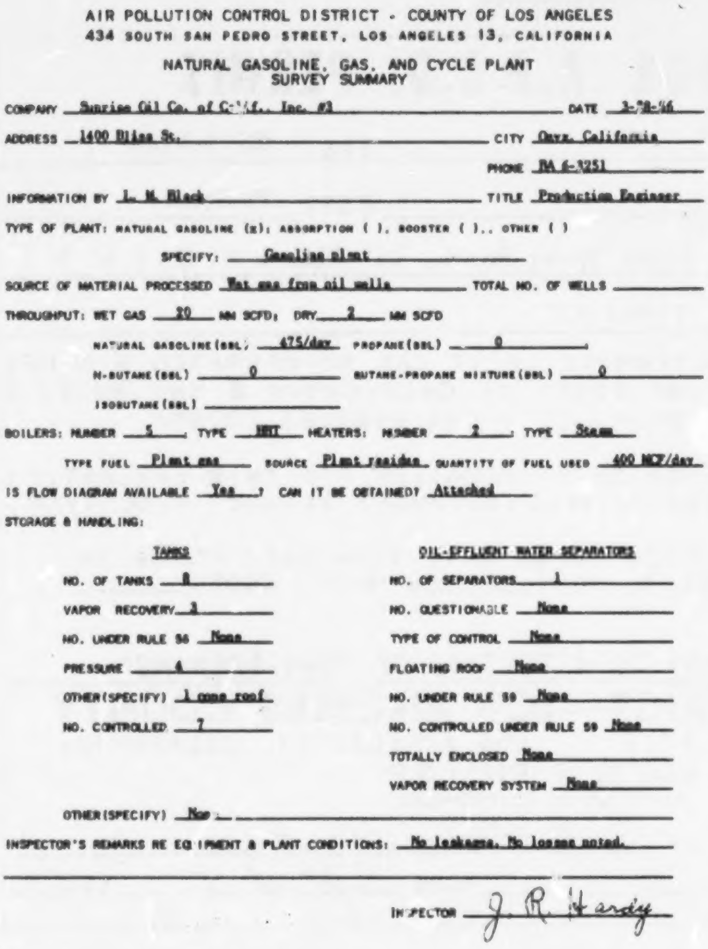
After the inspector has issued a Request to Apply for A.P.C.D. Permit form with accompanying application blanks, he makes an initial follow-up inspection to determine whether or not the applications were submitted to the A.P.C.D. If the inspector learns that the applications have been received by the District, the follow-up inspection need not be made. If, however, the inspector determines that the applications have not been received, he must make a follow-up inspection after the "due date" of the application — that is, after the 10th working day following issuance of the Request.

On the initial follow-up, the inspector writes an Inspector's Field Report setting forth the results of his inspection and all pertinent remarks made at that time by management. He then schedules another inspection in his own date book and continues to return thereafter until the matter is resolved.

Should the inspector, on subsequent follow-ups, observe that the equipment is not in operation, he indicates this fact in his date book, sets the source up for investigation within 2 or 3 days and indicates on his Daily Report that a stop has been made at the premises involved. On these follow-ups no Inspector's Green Field Report need be written.

If on any follow-up inspection the inspector finds the subject equipment in operation, he immediately writes an F-Type Notice for Section 24279 violation giving all pertinent information on the reverse of the pink copy of the notice. If the manager needs more time to submit the applications to A.P.C.D., he phones the A.P.C.D. Headquarters may, after considering the validity of management's reason for delay, grant an extension of time. The inspector should then revisit the plant on the date the extension expires.

If on any follow-up inspection the inspector learns that the matter has been resolved, either through proper application for permit, the removal of the equipment involved or the issuance of an F-Type Permit Notice, the inspector writes an Inspector's Green Field Report covering all previous follow-up inspections. This final follow-up inspection report includes the dates equipment were reinspected, as recorded in



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA

NATURAL GASOLINE, GAS, AND CYCLE PLANT
SURVEY SUMMARY

COMPANY Sunrise Oil Co. of Calif., Inc. #3 DATE 3-28-56
ADDRESS 1400 Bliss St. CITY Onyx, California
PHONE BA 6-3251
INFORMATION BY L. M. Black TITLE Production Engineer
TYPE OF PLANT: NATURAL GASOLINE (x); ABSORPTION ( ), BOOSTER ( ), OTHER ( )
SPECIFY: Gasoline plant
SOURCE OF MATERIAL PROCESSED Wet gas from oil wells TOTAL NO. OF WELLS
THROUGHPUT: WET GAS 20 MM SCFD; DRY 2 MM SCFD
NATURAL GASOLINE (BBL) 475/day PROPANE (BBL) 0
N-BUTANE (BBL) 0 BUTANE-PROPANE MIXTURE (BBL) 0
ISOBUTANE (BBL)
BOILERS: NUMBER 5; TYPE HRT HEATERS: NUMBER 2; TYPE Steam
TYPE FUEL Plant gas SOURCE Plant residue QUANTITY OF FUEL USED 400 MCF/day
IS FLOW DIAGRAM AVAILABLE Yes ? CAN IT BE OBTAINED? Attached
STORAGE & HANDLING:

TANKS		OIL-EFFLUENT WATER SEPARATORS	
NO. OF TANKS	8	NO. OF SEPARATORS	1
VAPOR RECOVERY	3	NO. QUESTIONABLE	None
NO. UNDER RULE 56	None	TYPE OF CONTROL	None
PRESSURE	4	FLOATING ROOF	None
OTHER (SPECIFY)	1 cone roof	NO. UNDER RULE 59	None
NO. CONTROLLED	7	NO. CONTROLLED UNDER RULE 59	None
		TOTALLY ENCLOSED	None
		VAPOR RECOVERY SYSTEM	None

OTHER (SPECIFY) None
INSPECTOR'S REMARKS RE EQUIPMENT & PLANT CONDITIONS: No leakage. No losses noted.
INSPECTOR J. R. Hardy

Figure XIV - 15. Natural gasoline, gas, and cycle plant survey summary.

the inspector's date book, and any other notes taken.

3. Follow-up on Service of Section 24279 F-Notice

Generally speaking, the same procedure as described above should be followed after an F-Type notice for violation of Section 24279 has been served in those cases in which the construction of equipment is completed. If the equipment is in operation, a notice is written each day the equipment is operated after the due date. If the equipment, however, is under construction, the inspector returns the day following the issuance of the notice to determine whether construction is continuing. If further construction is observed, another F-Notice is issued for construction without a permit. The inspector then issues an F-Notice for each day he observes unpermitted construction underway.

4. Writing the Report for Permit Follow-up

Follow-ups are prepared on the Inspector's Field Report. In the blank "This Report Covers", the inspector writes in "Permit Follow-up". Under "Findings", the date applications were issued, the date due, and any extension of time allowed by Headquarters are shown. The number and description of equipment concerned with the permit follow-up should also be mentioned, as well as any facts relative to operation of the equipment.

Under Statements and Remarks, the Inspector's Report should show if the applicant did or did not sub-

AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES - AREA GRID NO. 8 TFU M.R.NO. 01 -1

TYPES OF CONTAMI-NANTS			
A		E	
B		F	X
C		G	
D		O	

FIRM NAME Los Angeles Petroleum Company (XXI) TEL. TA4-2359 A.P.C.D. ZONE 25
ADDRESS OF PREMISES 12486 S. Oil Road POSTAL ZONE -- CITY Torrance
NATURE OF BUSINESS Petroleum Refining
RESPONSIBLE PERSON TO CONTACT John Doe TITLE Engineer

INSPECTION REPORT

TANK GROUP NO. 4. TANK LIST PREPARED BY George Smith. DATE Dec. 1 19 59

Reinspection Record on Back of Sheet

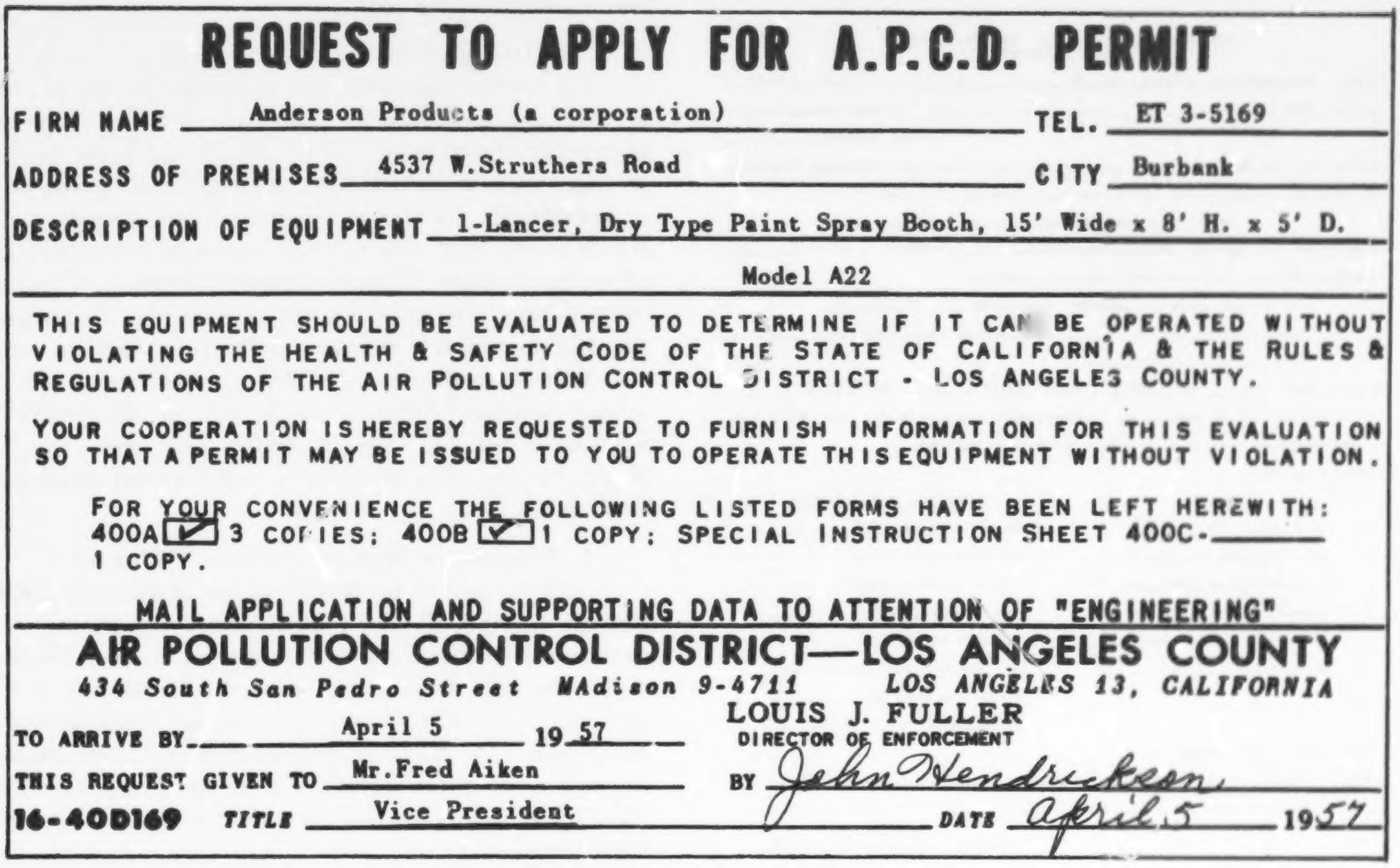
Tank No.	Ht.	Dia.	Type	Gen. Cond.	Product Stored	RVP (lb.)	Prod. Stg. Temp.	Service	Vapor Control	Permit Status	Rules Affected	Remarks
34	29'	30'	C	G	Gasoline	9	ambient	storage	VR	Rule 13	Rule 10, 56	
35	30'	30'	C	G	Stove Oil	negl.	''	''	N	Rule 11-h-5 Rule 13	None	Now off Vapor Recovery
42	12'	60'	C	G	--	--	--	--	N	Rule 13	None	Temporarily out of service
54	30'	40'	C	G	Aviation Gaso.	6	ambient	storage	VR	#10092	Rule 10, 56	
81	51'	110'	F	G	Gasoline	9	''	''	F (SS)	#19463	Rule 10, 56	sl. odors
93	35' L.	14'	H-P	G	n-Butane	50	''	''	PVV-VR	Rule 11-h-3	None	
142	51'	40'	F	G	Diesel	negl.	''	''	F (SS)	A-1990 Rule 11-h-5	Rule 10	Formerly stored gasoline

Codes and Standard Terminology
Type: C-Fixed Roof; F-Floating Roof; P-Pressure; O-Open Top; S-Spheroid; H-Horizontal; U-Underground
Cond.: G-Good; P-Poor; B-Bad
Service: Rundown; Storage; Blending or Mixing
Control: N-None; PVV-Conservation Vents; F-Floating Roof (SS-Single Seal; DS-Double Seal); V.R.-Vapor Recovery; V.D.-Vapor Disposal; V.B.-Vapor Balance.

40D330

Sheet ______ of ______

Figure XIV - 16. Tank inspection report.



REQUEST TO APPLY FOR A.P.C.D. PERMIT

FIRM NAME Anderson Products (a corporation) TEL. ET 3-5169

ADDRESS OF PREMISES 4537 W.Struthers Road CITY Burbank

DESCRIPTION OF EQUIPMENT 1-Lancer, Dry Type Paint Spray Booth, 15' Wide x 8' H. x 5' D.
Model A22

THIS EQUIPMENT SHOULD BE EVALUATED TO DETERMINE IF IT CAN BE OPERATED WITHOUT VIOLATING THE HEALTH & SAFETY CODE OF THE STATE OF CALIFORNIA & THE RULES & REGULATIONS OF THE AIR POLLUTION CONTROL DISTRICT - LOS ANGELES COUNTY.

YOUR COOPERATION IS HEREBY REQUESTED TO FURNISH INFORMATION FOR THIS EVALUATION SO THAT A PERMIT MAY BE ISSUED TO YOU TO OPERATE THIS EQUIPMENT WITHOUT VIOLATION.

FOR YOUR CONVENIENCE THE FOLLOWING LISTED FORMS HAVE BEEN LEFT HEREWITH: 400A ☑ 3 COPIES; 400B ☑ 1 COPY; SPECIAL INSTRUCTION SHEET 400C-______ 1 COPY.

MAIL APPLICATION AND SUPPORTING DATA TO ATTENTION OF "ENGINEERING"

AIR POLLUTION CONTROL DISTRICT—LOS ANGELES COUNTY

434 South San Pedro Street MAdison 9-4711 LOS ANGELES 13, CALIFORNIA

TO ARRIVE BY April 5 19 57

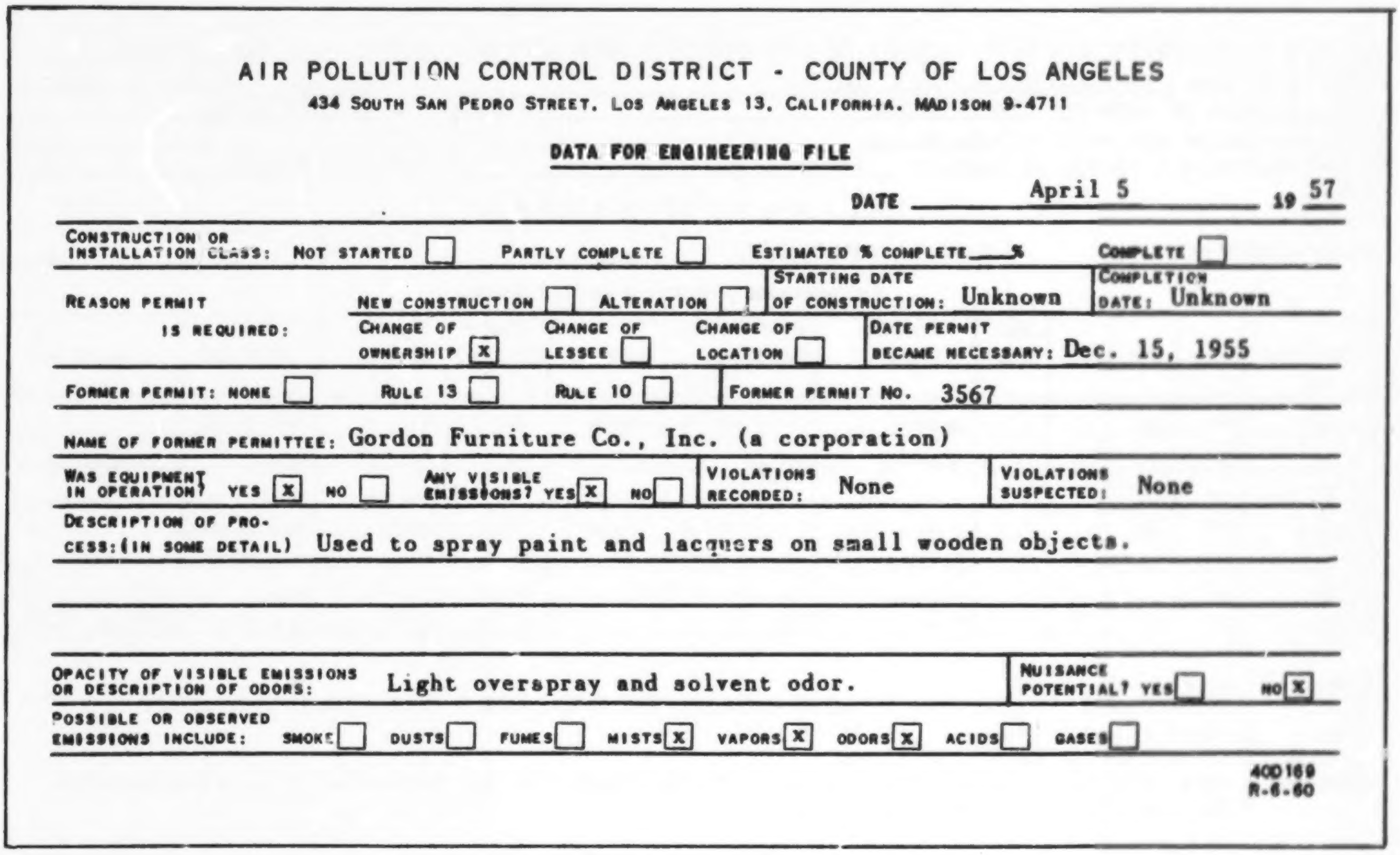
LOUIS J. FULLER
DIRECTOR OF ENFORCEMENT

THIS REQUEST GIVEN TO Mr.Fred Aiken

BY John Hendrickson

16-40D169 *TITLE* Vice President

DATE April 5 1957



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA. MADISON 9-4711

DATA FOR ENGINEERING FILE

DATE April 5 19 57

CONSTRUCTION OR INSTALLATION CLASS: NOT STARTED ☐ PARTLY COMPLETE ☐ ESTIMATED % COMPLETE ____% COMPLETE ☐

REASON PERMIT IS REQUIRED: NEW CONSTRUCTION ☐ ALTERATION ☐ STARTING DATE OF CONSTRUCTION: Unknown COMPLETION DATE: Unknown

CHANGE OF OWNERSHIP ☒ CHANGE OF LESSEE ☐ CHANGE OF LOCATION ☐ DATE PERMIT BECAME NECESSARY: Dec. 15, 1955

FORMER PERMIT: NONE ☐ RULE 13 ☐ RULE 10 ☐ FORMER PERMIT NO. 3567

NAME OF FORMER PERMITTEE: Gordon Furniture Co., Inc. (a corporation)

WAS EQUIPMENT IN OPERATION? YES ☒ NO ☐ ANY VISIBLE EMISSIONS? YES ☒ NO ☐ VIOLATIONS RECORDED: None VIOLATIONS SUSPECTED: None

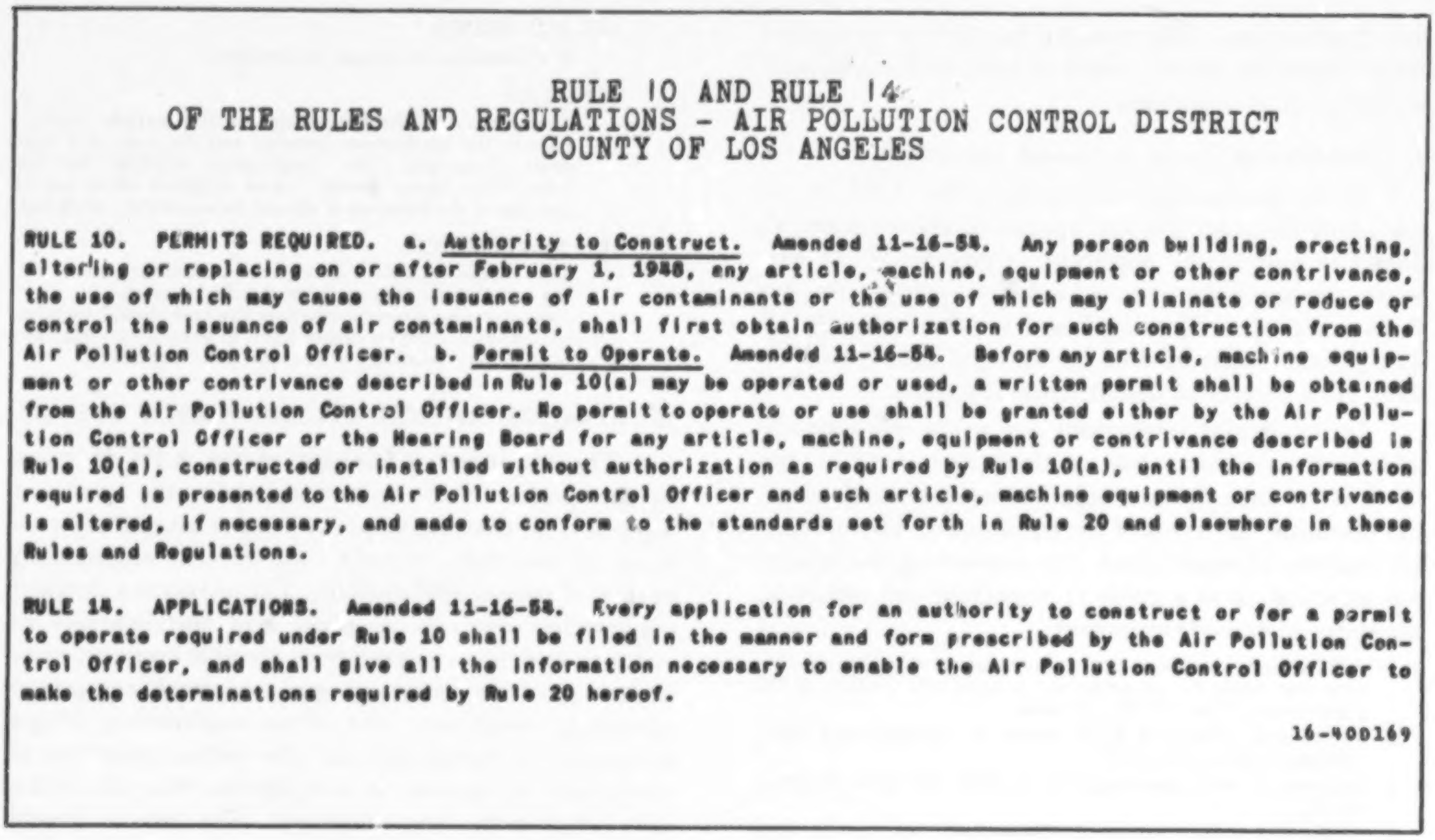
DESCRIPTION OF PROCESS: (IN SOME DETAIL) Used to spray paint and lacquers on small wooden objects.

OPACITY OF VISIBLE EMISSIONS OR DESCRIPTION OF ODORS: Light overspray and solvent odor. NUISANCE POTENTIAL? YES ☐ NO ☒

POSSIBLE OR OBSERVED EMISSIONS INCLUDE: SMOKE ☐ DUSTS ☐ FUMES ☐ MISTS ☒ VAPORS ☒ ODORS ☒ ACIDS ☐ GASES ☐

400D169
R-6-60

Figure XIV - 17. Request and office copies of the A.P.C.D. Permit Request.



RULE 10 AND RULE 14
OF THE RULES AND REGULATIONS - AIR POLLUTION CONTROL DISTRICT
COUNTY OF LOS ANGELES

RULE 10. PERMITS REQUIRED. a. Authority to Construct. Amended 11-16-54. Any person building, erecting, altering or replacing on or after February 1, 1948, any article, machine, equipment or other contrivance, the use of which may cause the issuance of air contaminants or the use of which may eliminate or reduce or control the issuance of air contaminants, shall first obtain authorization for such construction from the Air Pollution Control Officer. b. Permit to Operate. Amended 11-16-54. Before any article, machine equipment or other contrivance described in Rule 10(a) may be operated or used, a written permit shall be obtained from the Air Pollution Control Officer. No permit to operate or use shall be granted either by the Air Pollution Control Officer or the Hearing Board for any article, machine, equipment or contrivance described in Rule 10(a), constructed or installed without authorization as required by Rule 10(a), until the information required is presented to the Air Pollution Control Officer and such article, machine equipment or contrivance is altered, if necessary, and made to conform to the standards set forth in Rule 20 and elsewhere in these Rules and Regulations.

RULE 14. APPLICATIONS. Amended 11-16-54. Every application for an authority to construct or for a permit to operate required under Rule 10 shall be filed in the manner and form prescribed by the Air Pollution Control Officer, and shall give all the information necessary to enable the Air Pollution Control Officer to make the determinations required by Rule 20 hereof.

16-400169

Figure XIV - 18. Reverse side of the advice copy of the A.P.C.D. Permit Request.

mit applications. The reasons for failure to submit them should be shown, together with any subsequent warnings or observations.

G. *Denials and Denial Follow-up Inspections*

If the applications submitted to the A.P.C.D. by the plant manager are not approved, then a letter of denial is sent to the applicant. Upon receipt of this letter, the applicant may, if he desires, petition the Air Pollution Control Hearing Board to review the denial. The petition must be filed by the applicant within 10 days after receipt of denial. (See Chapter 6.)

Initial denial inspections are made immediately and continued every two or three days, and on the tenth day, when the privilege for petition has expired, to determine the status of the equipment. The inspector receives a Denial Check Slip containing the following information as a guide to inspecting and reporting the status of denied equipment:

1. Application number and a notation as to whether application was made for an authority to construct (A/C), or for permit to operate (P/O), or both.
2. Name and address of legal owner or company and DBA (Doing Business As) title.
3. Address at which equipment is located, and type of equipment.
4. Name and title of person to whom denial was served, date and method of service (certified mail or served in person).
5. Sector number.
6. Reinspection Dates—If no date is inserted by Headquarters in this column, the inspector should follow up on denial, as outlined in this chapter. If a date or dates appear here, the inspector should make an inspection on or about the last date shown.

At the time the initial inspection follow-up of the denial is made or on the first occasion that the inspector contacts management, he should check the equipment for any indication of operation, if the equipment is still present. The inspector then prepares an Inspector's Field Report setting forth the results of his inspection and all pertinent remarks made at the time by management.

If the inspector finds the equipment in operation at any time after the tenth day denial follow-up, he issues an F-Type Notice for violation of Section 24279. If on that and subsequent follow-up inspections the inspector determines that management has completely removed the equipment, or the equipment is otherwise definitely secured against future use, the inspector may then recommend filing of the Inspector's Report and the denial check slip.

If the equipment is not in operation on the inspector's initial follow-up, but evidence indicates the equipment is being used, it should be reported. The inspector then reinspects at times he suspects operation.

In preparing a report for denial follow-up, the general report procedures should be employed as discussed elsewhere in the chapter. In particular the following should be complied with:

THIS REPORT COVERS:
The words "Denial Follow-Up "should be used.

NOTICE ISSUED:
If F-Notices are issued, so indicate.

FINDINGS:
This portion of the Report should also include a reference to the application number and the type of equipment. Example: "Re: Application B-34567 for dry type Force Spray Booth." Any evidence as to use or non-use of the equipment should be accurately recorded.

HIS STATEMENT:
This should include a statement by management showing whether or not equipment is being used.
Inspector recommends whether the case should be filed, or whether further observation is necessary. He also records any warnings given and laws explained.

II ADMINISTRATION OF THE PERMIT SYSTEM

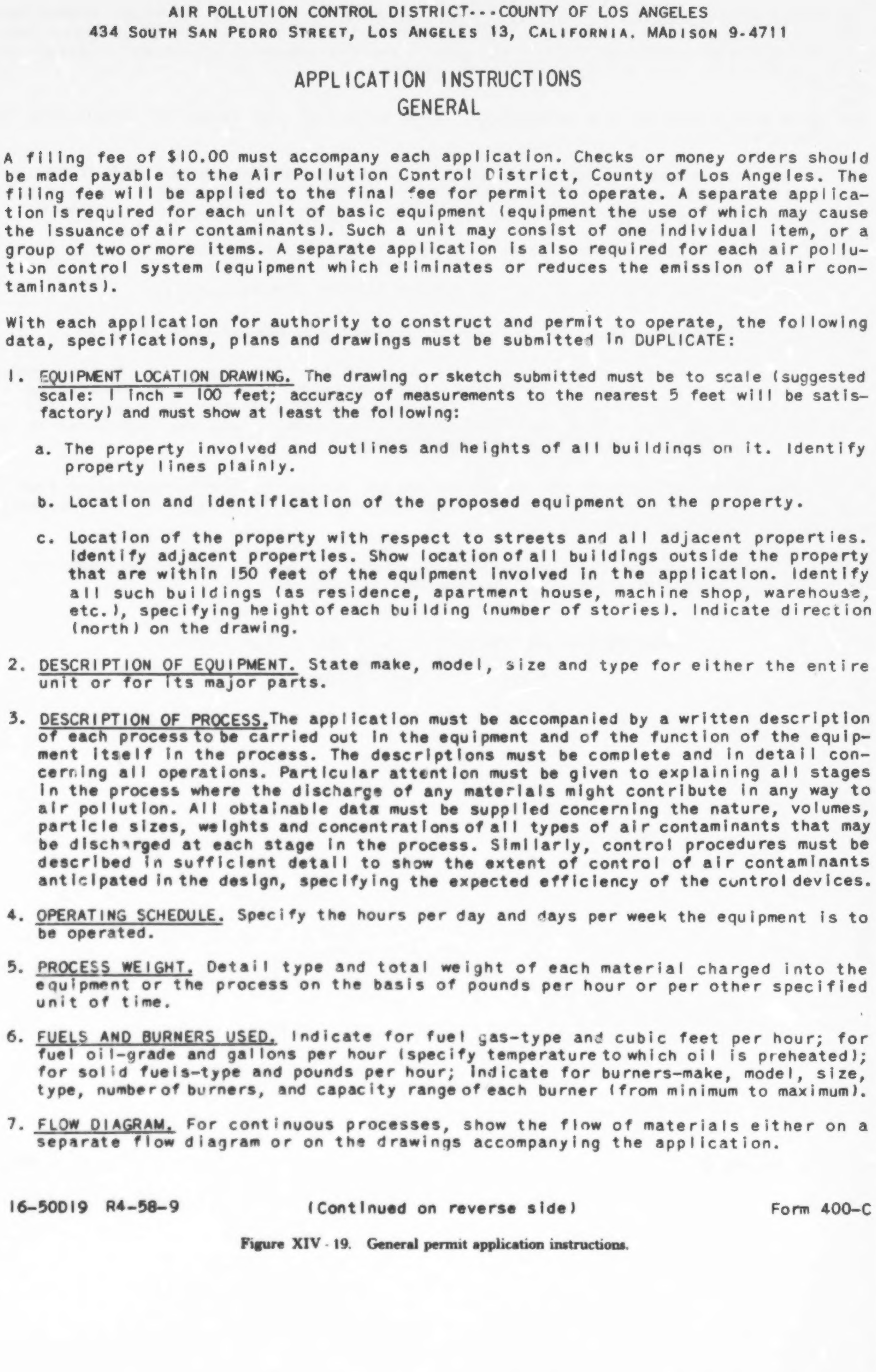
The Engineering Division of the A.P.C.D. takes up that portion of the task of registering the sources of air pollution that the inspector cannot adequately perform in the field, namely, the careful engineering review of permit applications. This involves a detailed engineering analysis of plans and specifications in order to determine as exactly as possible emission rates under optimum, minimal and maximal equipment operating conditions. The actual engineering design parameters of equipment, i.e., the various capacities of equipment to operate in compliance with the Rules and Regulations, are computed. The results should lead directly either to prevention of future air pollution problems, or correction or elimination of an existing problem.

The permit system involves, then, under Rule 10, the orderly filing of applications for authority to construct (including alteration and relocation) and permits to operate, together with all necessary information, plans and specifications which may be required, for certain classes of equipment located in all cities and unincorporated areas of Los Angeles County. The Permit System is governed by Rules 10 through 25 in the official Rules and Regulations of the Los Angeles County A.P.C.D.

A.—Application for A.P.C.D. Permit

The A.P.C.D. distributes application forms and instruction sheets to assist firms in applying for the Authority to Construct and Permit to Operate. These forms are issued by the Engineering or Enforcement Divisions whenever they are requested, or they are automatically issued by inspectors whenever a Request to Apply for A.P.C.D. Permit is written or an F-Notice for Violation of Section 24279 is served.

The application consists of two parts. The first part is the application which requests the *authority to construct* (if the equipment is not yet constructed) and the *permit to operate*, proper (see Figure XIV-20). The application identifies the individual, company, lessee, partnership or corporation operating the equipment, requesting all information necessary for a proper definition of the person(s) involved. (See page 216, Chapter 13.) The application also gives a description of the equipment, the estimated cost of equipment or



AIR POLLUTION CONTROL DISTRICT---COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA. MADISON 9-4711

APPLICATION INSTRUCTIONS
GENERAL

A filing fee of $10.00 must accompany each application. Checks or money orders should be made payable to the Air Pollution Control District, County of Los Angeles. The filing fee will be applied to the final fee for permit to operate. A separate application is required for each unit of basic equipment (equipment the use of which may cause the issuance of air contaminants). Such a unit may consist of one individual item, or a group of two or more items. A separate application is also required for each air pollution control system (equipment which eliminates or reduces the emission of air contaminants).

With each application for authority to construct and permit to operate, the following data, specifications, plans and drawings must be submitted in DUPLICATE:

1. EQUIPMENT LOCATION DRAWING. The drawing or sketch submitted must be to scale (suggested scale: 1 inch = 100 feet; accuracy of measurements to the nearest 5 feet will be satisfactory) and must show at least the following:
    a. The property involved and outlines and heights of all buildings on it. Identify property lines plainly.
    b. Location and identification of the proposed equipment on the property.
    c. Location of the property with respect to streets and all adjacent properties. Identify adjacent properties. Show location of all buildings outside the property that are within 150 feet of the equipment involved in the application. Identify all such buildings (as residence, apartment house, machine shop, warehouse, etc.), specifying height of each building (number of stories). Indicate direction (north) on the drawing.
2. DESCRIPTION OF EQUIPMENT. State make, model, size and type for either the entire unit or for its major parts.
3. DESCRIPTION OF PROCESS. The application must be accompanied by a written description of each process to be carried out in the equipment and of the function of the equipment itself in the process. The descriptions must be complete and in detail concerning all operations. Particular attention must be given to explaining all stages in the process where the discharge of any materials might contribute in any way to air pollution. All obtainable data must be supplied concerning the nature, volumes, particle sizes, weights and concentrations of all types of air contaminants that may be discharged at each stage in the process. Similarly, control procedures must be described in sufficient detail to show the extent of control of air contaminants anticipated in the design, specifying the expected efficiency of the control devices.
4. OPERATING SCHEDULE. Specify the hours per day and days per week the equipment is to be operated.
5. PROCESS WEIGHT. Detail type and total weight of each material charged into the equipment or the process on the basis of pounds per hour or per other specified unit of time.
6. FUELS AND BURNERS USED. Indicate for fuel gas-type and cubic feet per hour; for fuel oil-grade and gallons per hour (specify temperature to which oil is preheated); for solid fuels-type and pounds per hour; Indicate for burners-make, model, size, type, number of burners, and capacity range of each burner (from minimum to maximum).
7. FLOW DIAGRAM. For continuous processes, show the flow of materials either on a separate flow diagram or on the drawings accompanying the application.

16-50D19 R4-58-9 (Continued on reverse side) Form 400-C

Figure XIV-19. General permit application instructions.

8. DRAWINGS OF EQUIPMENT. (See NOTE below.) Supply an assembly drawing, dimensioned and to scale, in plan, elevation and as many sections as are needed to show clearly the design and operation of the equipment and the means by which air contaminants are controlled. The following must be shown:

   a. Size and shape of the equipment. Show exterior and interior dimensions and features.

   b. Locations, sizes and shape details of all features which may affect the production, collection, conveying or control of air contaminants of any kind; location, size and shape details concerning all materials handling equipment.

   c. All data and calculations used in selecting or designing the equipment.

   d. Horsepower rating of all electric motors driving the equipment.

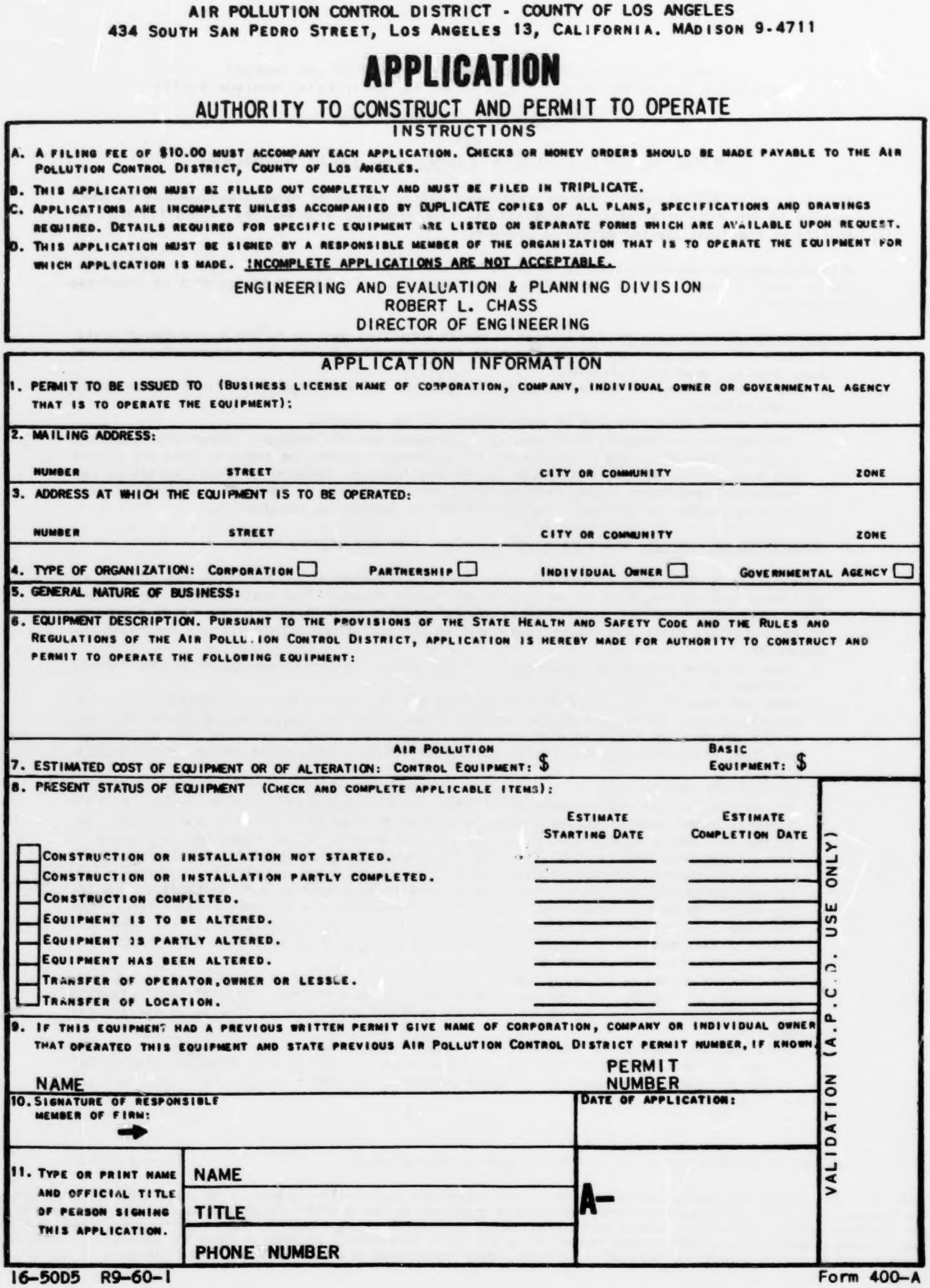
9. RADIOACTIVE MATERIAL. Describe any use or processing of radioactive material.

NOTE: Structural design calculations and details are not required. When standard commercial equipment is to be installed, the manufacturer's catalog describing the equipment may be submitted in lieu of the parts of Item 8 that it covers. All information required above that the catalog does not contain must be submitted by the applicant. ***ADDITIONAL INFORMATION MAY BE REQUIRED.***

After authority to construct or to install is granted for any equipment, deviations from the approved plans are not permissible without first securing additional approval for the changes from the Air Pollution Control Officer.

Further information or clarification concerning permits can be obtained by writing or calling the Permit Application Receiving Unit, MAdison 9-4711, Ext. 69.

ENGINEERING AND EVALUATION & PLANNING DIVISION
ROBERT L. CHASS
DIRECTOR OF ENGINEERING



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA. MADISON 9-4711

APPLICATION

AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE

INSTRUCTIONS

A. A FILING FEE OF $10.00 MUST ACCOMPANY EACH APPLICATION. CHECKS OR MONEY ORDERS SHOULD BE MADE PAYABLE TO THE AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES.

B. THIS APPLICATION MUST BE FILLED OUT COMPLETELY AND MUST BE FILED IN TRIPLICATE.

C. APPLICATIONS ARE INCOMPLETE UNLESS ACCOMPANIED BY DUPLICATE COPIES OF ALL PLANS, SPECIFICATIONS AND DRAWINGS REQUIRED. DETAILS REQUIRED FOR SPECIFIC EQUIPMENT ARE LISTED ON SEPARATE FORMS WHICH ARE AVAILABLE UPON REQUEST.

D. THIS APPLICATION MUST BE SIGNED BY A RESPONSIBLE MEMBER OF THE ORGANIZATION THAT IS TO OPERATE THE EQUIPMENT FOR WHICH APPLICATION IS MADE. INCOMPLETE APPLICATIONS ARE NOT ACCEPTABLE.

ENGINEERING AND EVALUATION & PLANNING DIVISION
ROBERT L. CHASS
DIRECTOR OF ENGINEERING

APPLICATION INFORMATION

1. PERMIT TO BE ISSUED TO (BUSINESS LICENSE NAME OF CORPORATION, COMPANY, INDIVIDUAL OWNER OR GOVERNMENTAL AGENCY THAT IS TO OPERATE THE EQUIPMENT):

2. MAILING ADDRESS:
NUMBER STREET CITY OR COMMUNITY ZONE

3. ADDRESS AT WHICH THE EQUIPMENT IS TO BE OPERATED:
NUMBER STREET CITY OR COMMUNITY ZONE

4. TYPE OF ORGANIZATION: CORPORATION ☐ PARTNERSHIP ☐ INDIVIDUAL OWNER ☐ GOVERNMENTAL AGENCY ☐

5. GENERAL NATURE OF BUSINESS:

6. EQUIPMENT DESCRIPTION. PURSUANT TO THE PROVISIONS OF THE STATE HEALTH AND SAFETY CODE AND THE RULES AND REGULATIONS OF THE AIR POLLUTION CONTROL DISTRICT, APPLICATION IS HEREBY MADE FOR AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE THE FOLLOWING EQUIPMENT:

7. ESTIMATED COST OF EQUIPMENT OR OF ALTERATION: AIR POLLUTION CONTROL EQUIPMENT: $ BASIC EQUIPMENT: $

8. PRESENT STATUS OF EQUIPMENT (CHECK AND COMPLETE APPLICABLE ITEMS):

	ESTIMATE STARTING DATE	ESTIMATE COMPLETION DATE
☐ CONSTRUCTION OR INSTALLATION NOT STARTED.		
☐ CONSTRUCTION OR INSTALLATION PARTLY COMPLETED.		
☐ CONSTRUCTION COMPLETED.		
☐ EQUIPMENT IS TO BE ALTERED.		
☐ EQUIPMENT IS PARTLY ALTERED.		
☐ EQUIPMENT HAS BEEN ALTERED.		
☐ TRANSFER OF OPERATOR, OWNER OR LESSEE.		
☐ TRANSFER OF LOCATION.		

9. IF THIS EQUIPMENT HAD A PREVIOUS WRITTEN PERMIT GIVE NAME OF CORPORATION, COMPANY OR INDIVIDUAL OWNER THAT OPERATED THIS EQUIPMENT AND STATE PREVIOUS AIR POLLUTION CONTROL DISTRICT PERMIT NUMBER, IF KNOWN.
NAME PERMIT NUMBER

10. SIGNATURE OF RESPONSIBLE MEMBER OF FIRM: ➡ DATE OF APPLICATION:

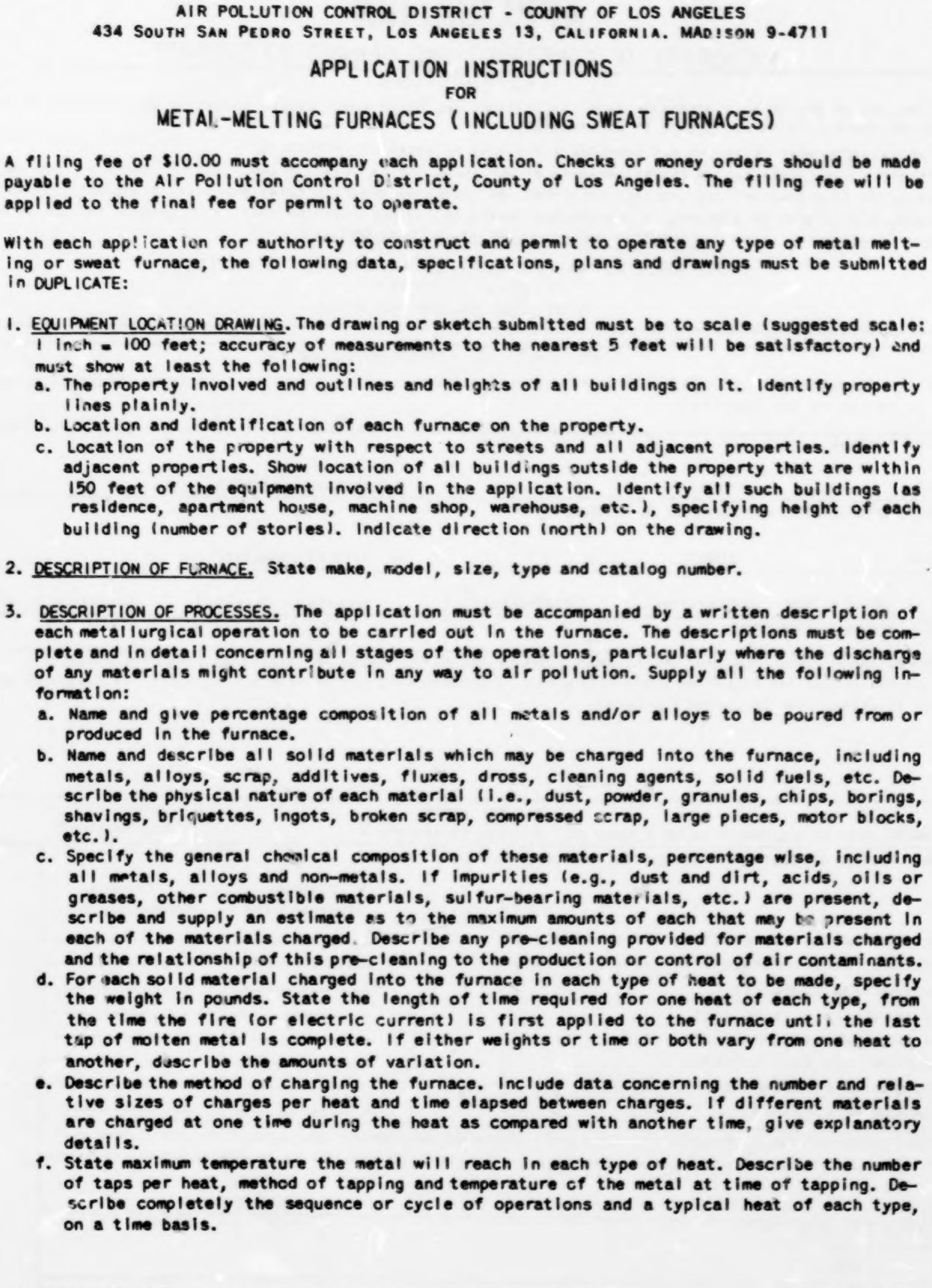
11. TYPE OR PRINT NAME AND OFFICIAL TITLE OF PERSON SIGNING THIS APPLICATION.
NAME
TITLE
PHONE NUMBER

A-

VALIDATION (A.P.C.D. USE ONLY)

16-5005 R9-60-1 Form 400-A

Figure XIV-20. Application for authority to construct and permit to operate equipment capable of air pollution.



AIR POLLUTION CONTROL DISTRICT - COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA. MADISON 9-4711

APPLICATION INSTRUCTIONS
FOR
METAL-MELTING FURNACES (INCLUDING SWEAT FURNACES)

A filing fee of $10.00 must accompany each application. Checks or money orders should be made payable to the Air Pollution Control District, County of Los Angeles. The filing fee will be applied to the final fee for permit to operate.

With each application for authority to construct and permit to operate any type of metal melting or sweat furnace, the following data, specifications, plans and drawings must be submitted in DUPLICATE:

1. EQUIPMENT LOCATION DRAWING. The drawing or sketch submitted must be to scale (suggested scale: 1 inch = 100 feet; accuracy of measurements to the nearest 5 feet will be satisfactory) and must show at least the following:
   a. The property involved and outlines and heights of all buildings on it. Identify property lines plainly.
   b. Location and identification of each furnace on the property.
   c. Location of the property with respect to streets and all adjacent properties. Identify adjacent properties. Show location of all buildings outside the property that are within 150 feet of the equipment involved in the application. Identify all such buildings (as residence, apartment house, machine shop, warehouse, etc.), specifying height of each building (number of stories). Indicate direction (north) on the drawing.

2. DESCRIPTION OF FURNACE. State make, model, size, type and catalog number.

3. DESCRIPTION OF PROCESSES. The application must be accompanied by a written description of each metallurgical operation to be carried out in the furnace. The descriptions must be complete and in detail concerning all stages of the operations, particularly where the discharge of any materials might contribute in any way to air pollution. Supply all the following information:
   a. Name and give percentage composition of all metals and/or alloys to be poured from or produced in the furnace.
   b. Name and describe all solid materials which may be charged into the furnace, including metals, alloys, scrap, additives, fluxes, dross, cleaning agents, solid fuels, etc. Describe the physical nature of each material (i.e., dust, powder, granules, chips, borings, shavings, briquettes, ingots, broken scrap, compressed scrap, large pieces, motor blocks, etc.).
   c. Specify the general chemical composition of these materials, percentage wise, including all metals, alloys and non-metals. If impurities (e.g., dust and dirt, acids, oils or greases, other combustible materials, sulfur-bearing materials, etc.) are present, describe and supply an estimate as to the maximum amounts of each that may be present in each of the materials charged. Describe any pre-cleaning provided for materials charged and the relationship of this pre-cleaning to the production or control of air contaminants.
   d. For each solid material charged into the furnace in each type of heat to be made, specify the weight in pounds. State the length of time required for one heat of each type, from the time the fire (or electric current) is first applied to the furnace until the last tap of molten metal is complete. If either weights or time or both vary from one heat to another, describe the amounts of variation.
   e. Describe the method of charging the furnace. Include data concerning the number and relative sizes of charges per heat and time elapsed between charges. If different materials are charged at one time during the heat as compared with another time, give explanatory details.
   f. State maximum temperature the metal will reach in each type of heat. Describe the number of taps per heat, method of tapping and temperature of the metal at time of tapping. Describe completely the sequence or cycle of operations and a typical heat of each type, on a time basis.

16-50D71 R2-58-9 (Continued on reverse side) Form 400-C-11

Figure XIV-21. Sample application instructions for typical equipment capable of air pollution: "Metal-Melting Furnaces (including sweat furnaces)". Special application instructions are issued to applicants by the A.P.C.D. for such equipment as ovens, concrete batch plants, multiple-chamber incinerators, organic solvent degreasers, spray booths, storage tanks for liquids and/or gases, and asphalt paving plants, exhaust systems utilizing such control equipment as dry filters (baghouses), scrubbers or other wet collectors, cyclones or other dry centrifugal or inertial separators, electrical precipitators, vapor incinerators or afterburners, and vapor adsorbers.

- g. If air or any other gas (oxygen, nitrogen, chlorine, etc.) is blown or bubbled through the molten metal, name the gas used and describe the method of use. Specify amount used (cubic feet or pounds) and the length of time required for this operation. State temperature of the metal at time of this operation.
- h. If any other refining methods are used, describe the operations on a time sequence basis.
- i. Describe all operational means to be used in controlling air contaminants. Information submitted must be specific concerning procedures, amounts, time, supervision to be provided, etc.
- j. If more than one furnace is to be connected to any type of air pollution control equipment, specify all combinations of furnaces that are to be operated at the same time.

4. DRAWINGS OF FURNACE. (See NOTE below.) Supply an assembly drawing, dimensioned and to scale, in plan and elevation. Show all of the following details which apply, using auxiliary drawings if necessary:
   - a. Over-all size and shape of the furnace, showing breeching (if any), stack and other external features.
   - b. Locations, sizes and shapes of all internal chambers, baffles and similar features.
   - c. Locations, sizes and shapes of all doors, holes, explosion or other vents, stacks, burner openings, tap-holes and spouts, slag-holes and spouts. Describe methods of sealing any vents other than the main stack.
   - d. Locations, sizes, shapes and means of controlling all dampers and similar devices.
   - e. Locations of all burners and all blowers supplying air to burners.
   - f. Location, size and shape details concerning any materials-handling and/or conveying equipment used in connection with the process carried out in the furnace.

5. OPERATING SCHEDULE. Hours per day and days per week the furnace is to be operated.

6. FUELS AND BURNERS USED. Indicate for fuel gas-type and cubic feet per hour; for fuel oil-grade and gallons per hour (specify temperature to which oil is preheated); for solid fuels-type and pounds per hour; indicate for burners-make, model, size, type, number of burners, and capacity range of each burner (from minimum to maximum). If air is supplied to the burner by a blower, specify the amount of air (cubic feet per minute) and the delivery pressure. Give following data on the blower set: name of manufacturer, model, size, type, blower speed in rpm, horsepower of connected motor. Describe any equipment to be used to control the input of air to the furnace. If furnace is electrically heated, specify whether heating is by direct arc, indirect arc or induction.

7. RADIOACTIVE MATERIAL. Describe any use or processing of radioactive material.

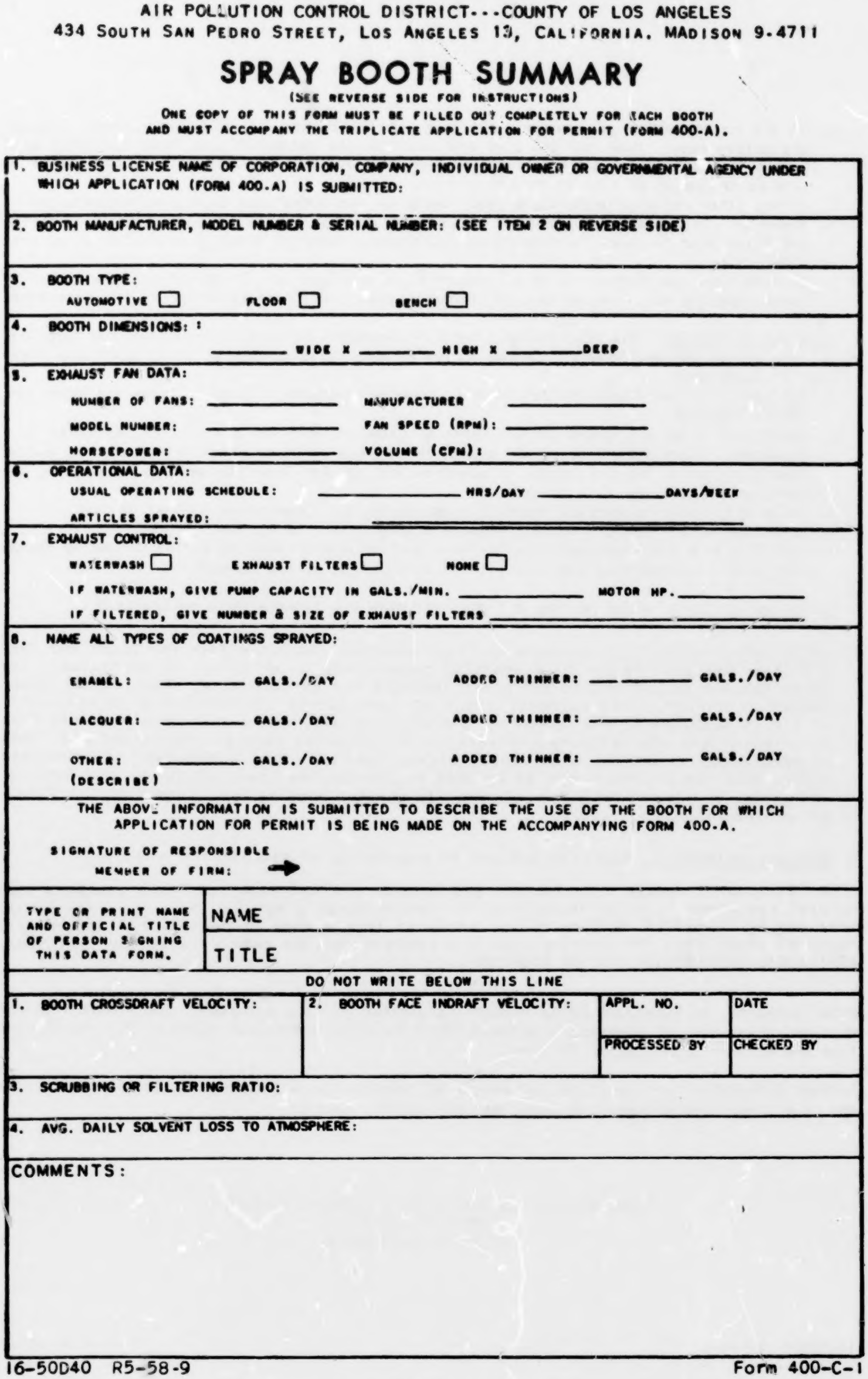
***NOTE:** Structural design calculations and details are not required. When standard commercial equipment is to be installed, the manufacturer's catalog describing the equipment may be submitted in lieu of the parts of Item 4 that it covers. All information required above that the catalog does not contain must be submitted by the applicant. ADDITIONAL INFORMATION MAY BE REQUIRED.*

After authority to construct or to install is granted for any equipment, deviations from the approved plans are not permissible without first securing additional approval for the changes from the Air Pollution Control Officer.

Further information or clarification concerning permits can be obtained by writing or calling the Permit Application Receiving Unit, MAdison 9-4711, Ext. 69.

ENGINEERING AND EVALUATION & PLANNING DIVISION
ROBERT L. CHASS
DIRECTOR OF ENGINEERING

16-50071 R2-58-9 Form 400-C-11



AIR POLLUTION CONTROL DISTRICT---COUNTY OF LOS ANGELES
434 SOUTH SAN PEDRO STREET, LOS ANGELES 13, CALIFORNIA. MADISON 9-4711

SPRAY BOOTH SUMMARY

(SEE REVERSE SIDE FOR INSTRUCTIONS)
ONE COPY OF THIS FORM MUST BE FILLED OUT COMPLETELY FOR EACH BOOTH
AND MUST ACCOMPANY THE TRIPLICATE APPLICATION FOR PERMIT (FORM 400-A).

1. BUSINESS LICENSE NAME OF CORPORATION, COMPANY, INDIVIDUAL OWNER OR GOVERNMENTAL AGENCY UNDER WHICH APPLICATION (FORM 400-A) IS SUBMITTED:

2. BOOTH MANUFACTURER, MODEL NUMBER & SERIAL NUMBER: (SEE ITEM 2 ON REVERSE SIDE)

3. BOOTH TYPE:
AUTOMOTIVE ☐ FLOOR ☐ BENCH ☐

4. BOOTH DIMENSIONS:
________ WIDE X ________ HIGH X ________ DEEP

5. EXHAUST FAN DATA:
NUMBER OF FANS: ____________ MANUFACTURER ____________
MODEL NUMBER: ____________ FAN SPEED (RPM): ____________
HORSEPOWER: ____________ VOLUME (CFM): ____________

6. OPERATIONAL DATA:
USUAL OPERATING SCHEDULE: ____________ HRS/DAY ____________ DAYS/WEEK
ARTICLES SPRAYED: ____________

7. EXHAUST CONTROL:
WATERWASH ☐ EXHAUST FILTERS ☐ NONE ☐
IF WATERWASH, GIVE PUMP CAPACITY IN GALS./MIN. ____________ MOTOR HP. ____________
IF FILTERED, GIVE NUMBER & SIZE OF EXHAUST FILTERS ____________

8. NAME ALL TYPES OF COATINGS SPRAYED:
ENAMEL: ________ GALS./DAY ADDED THINNER: ________ GALS./DAY
LACQUER: ________ GALS./DAY ADDED THINNER: ________ GALS./DAY
OTHER: ________ GALS./DAY ADDED THINNER: ________ GALS./DAY
(DESCRIBE)

THE ABOVE INFORMATION IS SUBMITTED TO DESCRIBE THE USE OF THE BOOTH FOR WHICH APPLICATION FOR PERMIT IS BEING MADE ON THE ACCOMPANYING FORM 400-A.

SIGNATURE OF RESPONSIBLE MEMBER OF FIRM: →

TYPE OR PRINT NAME AND OFFICIAL TITLE OF PERSON SIGNING THIS DATA FORM.
NAME
TITLE

DO NOT WRITE BELOW THIS LINE

1. BOOTH CROSSDRAFT VELOCITY:	2. BOOTH FACE INDRAFT VELOCITY:	APPL. NO.	DATE
		PROCESSED BY	CHECKED BY

3. SCRUBBING OR FILTERING RATIO:

4. AVG. DAILY SOLVENT LOSS TO ATMOSPHERE:

COMMENTS:

16-50D40 R5-58-9 Form 400-C-1

Figure XIV - 22. Reverse of application instructions for spray booths. For commonly used equipment such as spray booths, ovens, degreasers, etc., involving standard data and dimensions which may be readily supplied for calculations to determine air pollution potentials and compliance, a data summary similar to the above is included on the reverse of the special instructions for completion by the applicant.

alteration, the present status of equipment, signature of responsible persons, etc. In general it secures data similar to that collected by the inspector on an inventory inspection. Because it is prepared under the owner's or operator's signature, however, the operator is legally responsible for the correctness of all information furnished.

The second part consists of engineering data necessary for a thorough evaluation of the design of the equipment in order to determine whether or not the equipment is so designed, controlled or equipped that it can operate without violating any provision of the Rules and Regulations. For this purpose a number of standardized application instructions have been devised to collect the data required for evaluation of certain types of equipment. Such forms not only guide the applicant in supplying the specific data required, but also greatly facilitate the engineering review of applications. For special equipment, or equipment which requires unique handling, the applicant must supply data as required from the General Application Instructions (Figure XIV-19) and by inquiry from the District.

A separate application must be filed for each "permit unit" of basic and air pollution control equipment. Upon review of applications, the A.P.C.D. may require additional information, or regroup equipment on applications in order that the correct number of permit units are applied for. A written authority to construct must be received by the applicant before any construction, erection, installation, alteration, or replacement is undertaken.

The person (corporation, company, lessee, partnership or individual owner) operating the equipment is obligated to file the application, along with a filing fee of $10.00. In addition to the filing fee, the applicant, when notified by letter, must pay a fee for the issuance of each permit in the amount prescribed in Rule 40. The filing fee is applied to the fee prescribed for the issuance of the permit to operate. This latter fee is based on the ratings and capacities of equipment associated in the permit unit. The schedules in Rule 40 are grouped according to the following:

1. Electric motor ratings, in horsepower.
2. Design fuel consumption, in Btu.
3. Electrical energy ratings, in Kva.
4. Incinerator and refuse burner grate size ratings, in square feet.
5. Stationary container capacities, in gallons or cubic equivalent.

B. *Engineering Review*

After all such data have been received, the next step is to determine the actual pollution potentials of the equipment as a means of determining compliance with the control regulations. This is done by (1) analysis of the data submitted with the application, performing the necessary calculations, determining capacities, design factors and emission rates, and (2) engineering field inspection to confirm at first hand the performance of such equipment and air pollution potentials under critical operating conditions.

An application number is assigned to the application folder of the permit unit. This folder contains the applications for authority to construct, permit to operate, engineering calculations, engineering reports, all correspondence involved, inspector's permit requests, inspection reports made with reference to engineering requests, plot plans, drawings and check sheets for final inspections, etc., as well as *Engineering Final Reports* of visible emissions. These records trace the process of evaluation, and provide the bases of judgment necessary for approval or denial in each case. The actual evaluation, of course, involves the various engineering disciplines, and is beyond the scope of this manual.

During the final engineering field inspection, the following steps are taken:*

1. The engineer checks against the blueprint specifications and other data to determine whether or not the equipment is exactly as shown. Other important items are also checked off against a prepared check sheet.
2. The person designated as the operator operates the equipment in the presence of the engineer. The engineer, who is trained to read visible emissions, judges the opacities or densities of the emission and otherwise checks the equipment. If there is a problem involving "invisible" contaminants, source testing may be required. On the basis of previous tests, the engineer determines the quantity of product flow or material and estimates the losses to the atmosphere, material discharged in pounds per day, with and without the use of the control device.
   In general, the entire cycle of operation, from initiation to conclusion is observed. If combustion equipment is involved, it is generally observed from a cold start. All types of material which would be used by the company in the equipment is run for the engineer. In some instances, the equipment might be purposely over-loaded in order to determine quantities of contaminants that would be emitted under extreme conditions.
3. The engineer prepares a final field report in accordance with the check sheet. Any deviation from applications, plot plans, etc., are noted.
4. The engineer then writes up a final engineering field report which (1) describes use of equipment, (2) shows source of information, (3) accounts for all components, capacities and materials or fuels employed, (4) analyzes critical phases of operation, (5) notes total pounds lost of all categories of pollution, and (6) recommends one of the following:
   a. Hold for reinspection.
   b. Issuance of conditional permit.
   c. Issuance of unconditional permit.
   d. Denial of the application.

The engineer is guided by Rule 20 which states that the Air Pollution Control Officer shall deny an authority to construct or a permit to operate if the applicant does not show that the equipment is so designed or controlled that it may be expected to operate without emitting air contaminants in violation of the Rules and Regulations.

Should a denial be indicated, the applicant is notified and a conference is held between the engineer and the applicant at the volition of either party in order to discuss the reasons for the denial. If at that time the operator can modify his equipment, he may be permitted to do so by altering or modifying the application. If, however, the application has been formally denied after direct action by the Engineering Division, a new application must be filed and the previous application canceled.

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* On occasion Engineering Inspectors of the Enforcement Division perform engineering final inspections, particularly for degreasers, spray booths, and multiple chamber incinerators.

C. *Issuing the Permit*

Should the engineer recommend that a permit be issued, his findings are reviewed by a Senior Engineer, and the actual permit is issued. This permit is assigned a number, which then remains valid as long as the operator continues to operate the equipment in compliance both with any conditions which may have been noted on the permit, and the Rules and Regulations of the A.P.C.D.

The conditions applied to permits greatly facilitate subsequent enforcement. Operation contrary to conditions of permits is a violation of Section 24280. If equipment violates Section 24280 and chronically violates maximum permissible emission standards (including public nuisances) legal action can not only be taken on a number of counts, but the permit itself can be revoked (see "Revocations or Suspensions of Permits" page 113, Chapter 6). Therefore subsequent enforcement can often correct for errors in judgment which may have been made in the original granting of the permit.

D. *Evaluation and Planning*

It is quite clear from the foregoing that air pollution control is basically an engineering science. The data compiled through the process of engineering review can be used to determine with a relatively high degree of validity and certainty what control standards and practices are required to achieve the "air quality" desired by the community. As will be recalled, in a severe and changing air pollution situation, the standards necessary to reduce air pollution potentials do not remain fixed, but change with the community. The standards also change as new technologies and control techniques develop. Furthermore, revelations in scientific knowledge pertaining to toxicity may alter air quality standards, thus changing the entire picture.

A permit system is thus well-adapted to control a changing and growing problem. An evaluation and planning operation based pyramidally on a permit-inventory structure can proceed with the utmost confidence. The permit system, through case-by-case engineering evaluation, controls the input, relevance and accuracy of data. Upon this structure, the evaluation and planning staff of the agency puts all data to their maximum possible use. It may, through special statistical techniques, keep emission factors up-to-date for all source categories, and refine limits of statistical error to facilitate accurate diagnoses and prognoses of air pollution problems. The data can be used for continuous maintenance of total pollution surveys, and hence, improve control standards, not only for legislation, but for equipment manufacturers as well. The evaluation staff may also compile extra-engineering data, especially with regard to the availability and cost of control equipment and fuels, to demonstrate the feasibility of proposed control methods. Members of the staff may also be assigned to the evaluation of new inventions and special problems and to the study of the prevention of future air pollution problems.

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